APPENDIX C
Geotechnical Assessment of the Project Levees

C-104591

RECONNAISSANCE REPORT
SAN JOAQUIN RIVER MAINSTEM, CALIFORNIA

August 1992

PREPARED BY

SOIL DESIGN SECTION

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1. INTRODUCTION. This writeup is prepared in response to Work Order Request AA104-02-OG1 from Central Valley Section. The purpose of the study was to determine the potential for Federal interest in solving the flood and related problems of the San Joaquin River system. Soil Design Section was requested to perform a geotechnical reconnaissance and general assessment of the levees in the system. The scope of the study included reviewing past problems and present conditions of the levees.

2. STUDY AREA DESCRIPTION. The levees in the San Joaquin River System study area are shown on the Index Map, Plate 1. They include levees on both banks of the San Joaquin River from Friant Dam downstream to Old River, Mariposa Bypass, Eastside Bypass, and Chowchilla Bypass. The actual length of the levees totalled 262 miles.

3. LOCAL DISTRICT SURVEY. On April 6, 1992 San Joaquin Basin Branch sent out a Local District Survey to identify flood control needs and problems to all Reclamation Districts located along San Joaquin River System. Only 6 of 19 Reclamation Districts responded. Several problems were identified in these responses. These included uncontrolled seepage, sand boils, slope sloughing, instability, bank erosion and low spots on levee crests. It is noted that loss of grade which results in inadequate levee height are local maintenance responsibilities. Therefore, only the levee problems associated with seepage, sand boils and instability are addressed in this report.

4. RECORD REVIEW. A review of available San Joaquin River System files revealed that only limited repairs to the project levees in the study area have been performed. This implies that the overall performance of the levees in the study area has been very good.

5. FIELD INSPECTION. Soil Design Section performed field inspections of all the project levees on the San Joaquin River System. A total of 278 miles of levees were inspected to include 262 miles of project levees and 16 miles of private levees. There are 18 Reclamation Districts along with the Lower San Joaquin Levee District responsible for maintaining the levees in the system. The results of the field inspection are described in study reaches 2-6. Appendix A lists and describes the problem areas and plates 1-21 show the location of problem areas. The following paragraphs describe the study from Reach 2 through 6. Reach 1 involved the mainstem immediately downstream of Friant Dam. This reach of river does not include levees and therefore is not discussed in this report.

a. REACH 2.

(1). Description. The levees in this reach are located along both banks of the San Joaquin River from Yuba Avenue (Road 21) downstream to the junction of the San Joaquin River and the Chowchilla Canal Bypass. It includes approximately 20 miles of levee, between river mile 216 and 227 as shown on Plates 2 and 3. The levees in this reach are maintained by the Lower San Joaquin Levee District.

(2). Levee Conditions. The levees in this reach are generally 0'- 8' in height, with 10'-13' crown widths, a 1V on 2H slope on the landside and a 1V on 3H slope on the riverside as shown on Plate 2. Levee materials generally consist of clay and sandy silt. Some reaches have riprap on the riverside levee toe. The levees appear to be in good condition, with no signs of settlement or erosion. Several areas were reported to have seepage in the past. These are apparently due to land leveling which created a landside lower than the waterside berm.

(3). Evaluation. In general, the levees investigated in Reach 2 appear stable and good condition.

b. REACH 3.

(1). Description. The levees in this reach include the Chowchilla Bypass, Eastside Bypass, Mariposa Bypass, both banks of the San Joaquin River from the Eastside Bypass downstream to the Merced River, the downstream portion of the Bear Creek, Owens Creek, Ash Slough, and Berenda Slough. It includes approximately 150 miles as show on Plates 3 through 14. The levees in this reach are maintained by the Lower San Joaquin Levee District.

(2). Levee Conditions. The levees in this reach are generally 5'- 12' in height, with 10'-15' crown widths, a 1V on 2H slope on the landside and a 1V on 3H slope on the riverside as shown on Plate 3. Levee materials generally consist of sandy silt, silty sand and clay. Foundation materials appear to be uniform throughout this reach. These materials typically include a 3'-5' clay or sandy silt layer underlain by mostly sandy or silty sand. The levees appear to be in good condition, with no sign of erosion or settlement. Several areas were reported to have seepage and sand boils in the past. These are apparently due to foundation soil conditions, landside irrigation ditches and land leveling which has created landside elevations lower than the waterside berm. There are two very large breaches on one reach of levee. One breach is located on the right bank levee of the San Joaquin River about 1.5 miles downstream from the Bear Creek confluence (Photo 1). The other breach is located on the right bank levee of the Eastside Bypass about 0.3 mile upstream from San Joaquin River bypass diversion (Photos 2 and 3). The breaches were reported to be man-made for the purpose of draining storm runoff back into the river system. The left side levee of Eastside Bypass between the San Joaquin River and the Mariposa Bypass is reported to be constructed lower than the opposite levee. There is a large sand bar build up in the Chowchilla Bypass about 0.5 mile downstream from San Joaquin River diversion. In several areas the river bank has

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eroded and the stream bed is getting closer to the levee toe. Along the right bank of the Eastside Bypass and Chowchilla Bypass, there are several areas that lack of vegetation. Since these levees are constructed of erodable silt and sand, flood flows result in loss of grade, slope erosion and associated deterioration of the levee crown.

(3). Evaluation. Overall, the existing condition of the levee is acceptable and well maintained. In some locations, the river erosion has reduced or eroded the waterside berm to within 30' and 50' from the levee toe. Although this is not critical, it should be closely monitored. When erosion has reduced the waterside berm to less than 30' from the levee toe bank protection should be provided. The breached levee section should be restored to original lines and grades. Culverts with flap gates could be used to drain backed-up water on the land side. Where seepage is a problem, irrigation ditches adjacent to the levee toes should be backfilled or relocated a minimum distance of 50' away from the levee toe.

c. REACH 4.

(1). Description. The levees in this reach are located along both banks of San Joaquin River from the confluence of the Merced River downstream to the confluence of the Toulumne River. It includes approximately 30 miles of levee, between river mile 84.0 and 118.0 as shown on Plates 15,16,17, and 18. The levee on the left bank is maintained by R.D. 2102 and R.D. 1602. The levee on the right bank is maintained by R.D. 2092, R.D. 2091, and R.D. 2063.

(2). Levee Conditions. The levees in this reach were constructed of sandy silt, silt and silty clay soils. These materials are erodible as is evidenced by the intermittently eroded banks on each side of the river. A typical section is 8'-14' in height with 10'-14' crown widths, a 1V on 2H slope on the landside and a 1V on 3H slope on the riverside as shown on Plates 15. In general, the levee appears to be in good condition. However, some minor rodent activity was observed. Riverbank erosion along R.D 2091 and R.D. 2063 was evident (Photos 4 and 5). There is one reach of the levee near river mile 109.3 where the levee and riverside slope are totally obscured with brush (Photo 6). In R.D. 2091, levee cracks were reported in 1986 at three locations near the Modesto Water Treatment and Disposal Facilities. However, those cracks were developed during an adjacent vibroflotation foundation treatment. These are not related to natural foundation instability. Also, seepage has been reported in the past in one area in R.D. 2063 between river mile 107.5 and 110.5. However, the significance of this seepage cannot be evaluated without additional foundation data and observation during floods.

(3). Evaluation. In general, the levees investigated in Reach 4 appear stable and in good condition. However, bank protection is recommended in areas where riverbank erosion is active and encroaching close to the levee toes.

d. REACH 5.

(1). Description. This reach includes both banks of the San Joaquin River from the confluence of the Toulumne River downstream to the confluence of the Stanislaus River. It includes approximately 22 miles of levee, between river mile 75.0 and 84.0 as shown on Plate 18, 19 and 20. The levee on left bank is maintained by R.D. 2101, R.D. 2099, R.D. 2100. The levee on the right bank is maintained by R.D. 2031.

(2). Levee Conditions. The levees in this reach are generally 8'-14' in height with 11'-17' crown widths, a 1V on 2H slope on the landside and a 1V on 3H slope on the riverside as shown on Plate 18. Levee material is mostly sandy silt to silty sand. The levee appears to be in fair condition with no signs of settlement or erosion. R.D. 2100 reported a problem at the crossing of the West Stanislaus Irrigation District main lift canal where some sloughing has occurred on both the riverside and the landside slope. This is a result of undercutting and consequent sloughing. This is considered a normal maintenance problem and should be repaired by the local reclamation district. Significant seepage has also been reported at this location. This crossing is approximately 30' in height with steep 1V on 0.5H slopes (Photos 7 and 8). There is one area in R.D. 2099 where the river has eroded to within approximately 21' of the levee toe. In several areas the road surface is poorly maintained with many pot holes along with a loss of grade.

(3). Evaluation. In general the existing condition of the levees in this reach is fair. Bank protection is recommended at a number of river erosion sites. Loss of grade, poor road surface which result in inadequate levee height are considered to be local maintenance responsibilities. It is impossible to evaluate the seriousness of the reported seepage condition at the West Stanislaus Irrigation District main lift canal crossing without more detailed information about the levee, foundation soil conditions and flow levels. However, overall the seepage and stability problems in this reach are considered minimal.

e. REACH 6.

(1). Description. The levees in this reach are located along both banks of San Joaquin River from the confluence of the Stanislaus River downstream to the confluence of the Old River. It includes approximately 40 miles of levees between river mile 53.4 and 75.0 as shown on Plates 19, 20 and 21. The levee on left bank is maintained by R.D. 2085, R.D. 2095, R.D. 2107, and R.D. 2062. The levee on the right bank is maintained by R.D. 2064, R.D. 2075, R.D. 2094, and R.D. 17.

(2). Levee Conditions. The levees from Old River upstream to the Southern Pacific R.R. are generally 15'- 17' in height with 13'- 26' crown widths as shown on Plate 21, while the rest of levees in this reach are 8'-12' in height with 10'-16' crown widths as shown on Plate 19. These levees have a 1V on 2H slope on the landside and a 1V on 3H slope on the riverside.

In several areas maintained by R.D. 2064 and R.D. 2095 ATV vehicles and other off road vehicles have created several trails across the levee embankment which result in loss of grade, slope erosion and deterioration of the levee crown (Photos 9, 10, and 24).

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There are two areas, one in R.D. 2085 and the other in R.D. 2094, where the river has eroded to within approximately 25' of the levee toe (Photos 11 and 18). In R.D. 2094 there is a large area of sand deposition in the San Joaquin River near river mile 60.6 (Photo 15). There is one area in R.D. 2075 where the levee foundation has developed cracking and open fissures (Photos 13 and 14). The foundation condition that resulted in cracking is unknown. It was reported that significant levee settlement and near failure occurred in this area in 1983. R.D. 2075 reported that several areas experienced seepage, sand boils, and sloughing in the past due to foundation conditions. Several levee reaches in R.D. 2095 and R.D. 2062 have been extensively eroded on both slopes. In addition, lack of maintenance is evident on the levee crown and upper slope of the levee in some areas. Some eroded areas at the crown of the levee extend 23'in length, 4' in depth (Photos 20-23 and 27-32). In R.D. 2062 and some portions of R.D. 17, there are a number of locations where rock revetment is needed. This is a very popular boating area on the river because of the Mossdale Boat Launching facility. Continuous pleasure boat traffic and water skiers are causing damage to the unprotected banks of the levee (Photos 17 and 26). In several areas, the road surface is poorly maintained with several pot holes, along with loss of grade, low spots, rodent activity, and vegetation overgrowth near the levee was observed (Photos 17, 19 and 25).

(3). Evaluation. Overall, the existing condition of Reach 6 is fair. There is some evidence of poor maintenance practices. This is particularly true in R.D. 2095 and R.D. 2062. The eroded levee sections should be repaired or restored. In some locations, erosion has progress near the levee toe and bank protection should be placed. Rodent holes in the levees should be backfilled and a rodent abatment program should be initiated. Excessive vegetation, loss of grade, and deteriorated road surfaces are considered a local maintenance responsibility.

7. SUMMARY. Based upon a field inspection of the levees in this study areas, the overall flood control project features are considered adequate. The primary problem is a lack of maintenance. Bank protection is locally needed. Set back levees in some reaches may be needed in the future. However, erosion problems, loss of grade, deteriorated road surfaces, and vegetation overgrowth are considered local maintenance responsibilities. Since the levees were inspected during relatively low summer water levels, seepage conditions could not be fully evaluated. To evaluate the potential for seepage problems, the levees should be inspected during flood conditions. In addition, explorations would be required where seepage or stability problems are reported.

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APPENDIX A

SAN JOAQUIN RIVER MAINSTEM PROBLEM AREAS

RIVER MILE	BANK	R.D.	REACH	SOURCE	DESCRIPTION OF AREA
54.1	Left	2062	6	Field Ins.	Levee erosion on the landside slope.
54.7	Left	2062	6	Field Ins.	Levee erosion on the landside slope.
56.4 - 56.6	Right	17	6	Field Ins.	River bank erosion.
57.5 - 57.8	Right	2094	6	Field Ins.	Numerous large rodent holes on both sides of the levee.
60.2	Left	2095	6	Field Ins.	Levee and riverside slope totally obscured with trees and brush.
60.2	Right	2094	6	Field Ins.	River bank erosion.
60.5 - 60.8	Left	2095	6	Field Ins.	Levee erosion on the landside slope.
60.5 - 60.7	Right	2094	6	Field Ins.	Sediment deposits midchannel.
61.4 - 61.6	Right	2075	6	R.D. 2075	Seepage
61.9 - 62.1	Right	2075	6	Field Ins.	Levee landside obscured with trees and brush.
62.7	Left	2095	6	Field Ins.	Deteriorated levee crown and slope created by vehicles.
63.4 - 63.6	Right	2075	6	R.D. 2075	Levee erosion, Boils, Sloughing, Seepage.
66.0	Right	2075	6	R.D. 2075	Boils
67.2 - 67.3	Right	2075	6	R.D. 2075 Field Ins.	Levee foundation damaged on riverside slope.
70.0	Left	2085	6	Field Ins.	River bank erosion
71.5 - 74.3	Right	2064	6	Files.	Heavy seepage during 1982
73.0 - 74.0	Right	2064	6	Field Ins.	Extensive ATV vehicles and off road motorcycles activities which result in loss of grade, slope erosion and deterioration of levee crown.
79.2 - 79.3	Left	2099	5	Field Ins.	River bank erosion
84.2	Left	2100	5, 4	R.D. 2100	Some sloughing, seepage has occurred at the crossing of West Stanislaus Main Canal.
100.7 - 100.8	Right	2091	4	Field Ins.	River bank erosion.
105.8 - 105.9	Right	2063	4	Field Ins.	River bank erosion
106.3 - 106.5	Right	2063	4	Field Ins.	Levee riverside obscured with brush.
106.0 - 106.1	Left	1602	4	Field Ins.	Numerous rodent holes on both sides of the levee.
107.4 - 110.6	Right	2063	4	R.D. 2063	Seepage has occurred during 1982.
109.3 - 109.4	Right	2063	4	Field Ins.	Levee riverside obscured with brush.
125.5 - 128.1	Right	LSJLD	3	LSJLD	Seepage due to area soil conditions.

RIVER MILE	BANK	R.D.	REACH	SOURCE	DESCRIPTION OF AREA
133.6 - 133.7	Right	LSJLD	3	Field Ins.	Levee breach (Reported to be manmade for the purpose of draining rainwater back into the river system).
137.5 - 143.5	Right	LSJLD	3	LSJLD	Seepage due to area soil conditions.
143.5 - 144.0	Right	LSJLD	3	LSJLD	Seepage due to landside ditch drain and area soil conditions.
148.5 - 149.5	Right	LSJLD	3	LSJLD	Seepage due to land development (land leveling which created landside lower than waterside berm) and area soil conditions.
168.4 - 170.8	Left	LSJLD	3	LSJLD	Seepage due to land development (land leveling which created landside lower than waterside berm) and area soil conditions.
216.0 - 225.0	Left	LSJLD	2	LSJLD	Seepage due to improperly designed and constructed levees (cross section insufficient and constructed with native material/sand; foundations were not keeled properly). Seepage due to land development (land leveling which created landside lower than waterside berm) and field tile drain pumping is pulling the fine material from the levee foundation.
216.0 - 226.8	Right	LSJLD	2	LSJLD	Seepage due to improperly designed and constructed levees (cross section insufficient and constructed with native material/sand; foundations were not keeled properly). Seepage due to land development (land leveling which created landside lower than waterside berm) and field tile drain pumping is pulling the fine material from the levee foundation.

SAN JOAQUIN RIVER TRIBUTARY PROBLEM AREAS

LEVEE MILE	BANK	R.D.	REACH	SOURCE	DESCRIPTION OF AREA
			EAST SIDE BYPASS		
0.3 - 0.4	Right	LSJLD	3	Field Ins.	Levee breach (Reported to be manmade for the purpose of draining rainwater back into the river system).
0.0 - 9.62	Left	LSJLD	3	LSJLD	Levee (left) built lower than opposite levee.
11.7 - 12.7	Left	LSJLD	3	LSJLD Field Ins.	Seepage due to area soil conditions and landside ditch drain.
12.7 - 18.4	Left	LSJLD	3	LSJLD	Seepage due to area soil conditions.
18.4 - 19.4	Left	LSJLD	3	LSJLD Field Ins.	Seepage due to area soil conditions and landside ditch drain.
21.0 - 22.0	Left	LSJLD	3	LSJLD	Seepage due to area soil conditions.
			CHOWCHILLA BYPASS		
9.0 - 13.7	Left	LSJLD	3	LSJLD	Seepage due to land development (county excavation between paved road and fence r.o.w. created landside lower than waterside berm).
14.6 - 15.0	Left	LSJLD	3	LSJLD	Sediment deposits in the middle of the channel.
13.0 - 15.0	Right	LSJLD	3	LSJLD	Seepage due to area soil conditions.

ABBREVIATIONS

R.D.	Reclamation District
LSJLD	Lower San Joaquin Levee District.
Field Ins.	Information from Soil Design Section field inspections.
Files	Information from San Joaquin River System File in Soil Design Section.

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FIGURES

C-104602

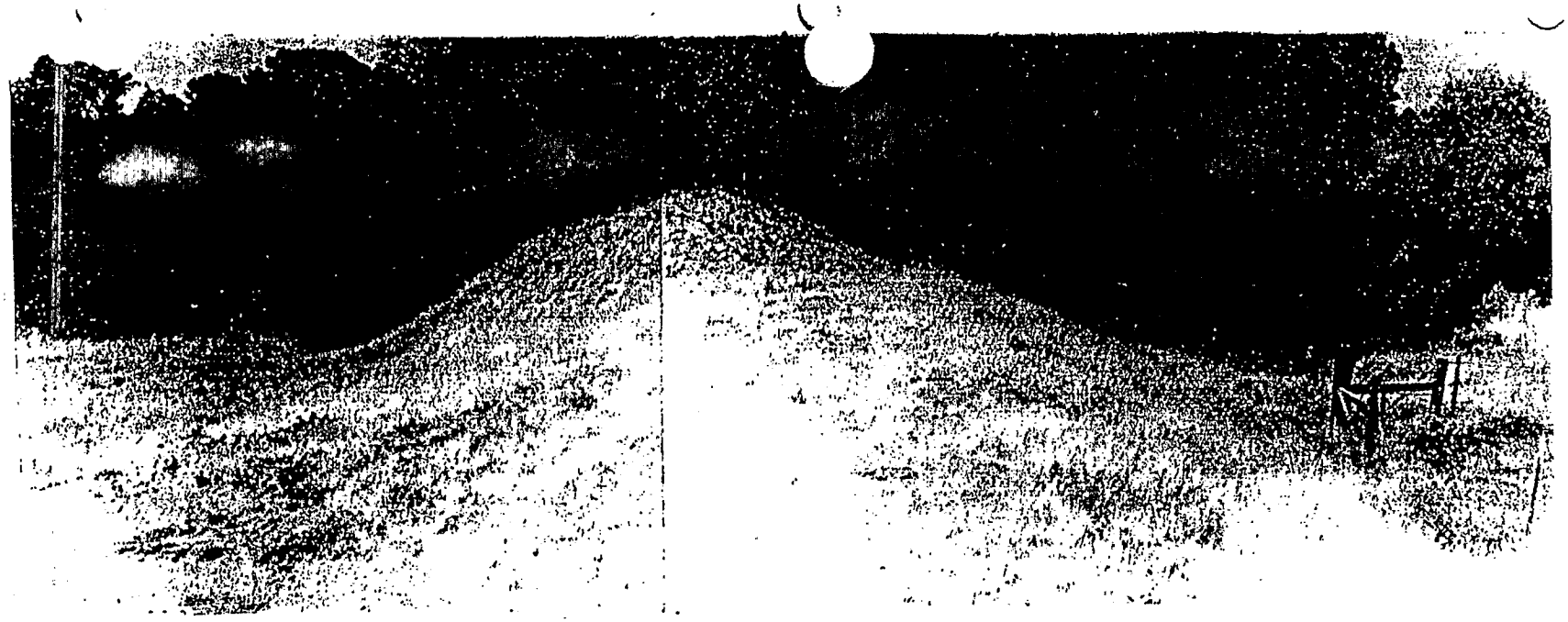


Photo 1

LEVEE BREACH

Photo 1: Levee breach on the right bank levee of the San Joaquin River at river mile 133.6, overgrowth vegetation at the breach. (Lower San Joaquin Levee District) (May 28, 1992)

Photo 2

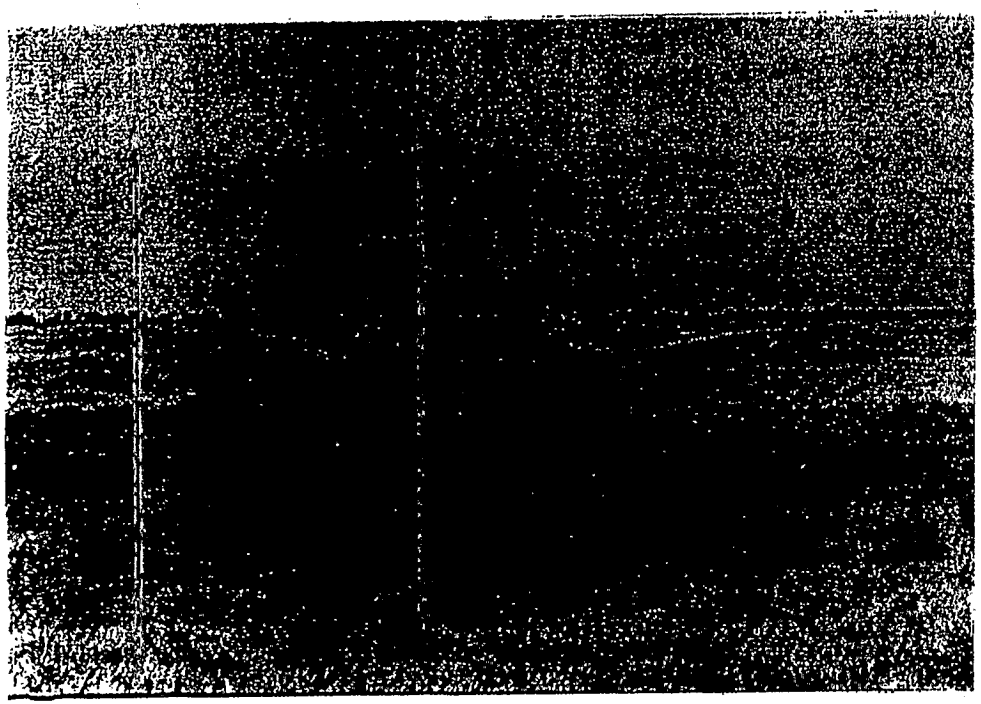


Photo 3

LEVEE BREACH

Photo 2 & 3: Levee breach on the right bank levee of the Bear Creek Bravel Slough about 0.25 mile upstream from San Joaquin River (Lower San Joaquin Levee District) (May 28, 1992)

Figure 2

Photo 4

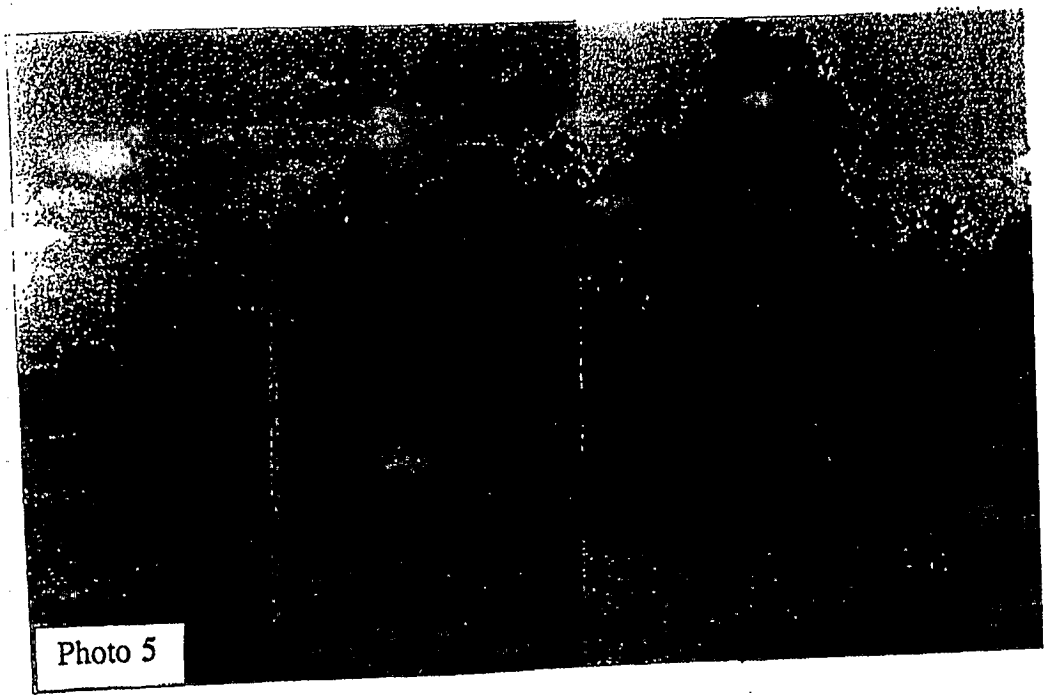
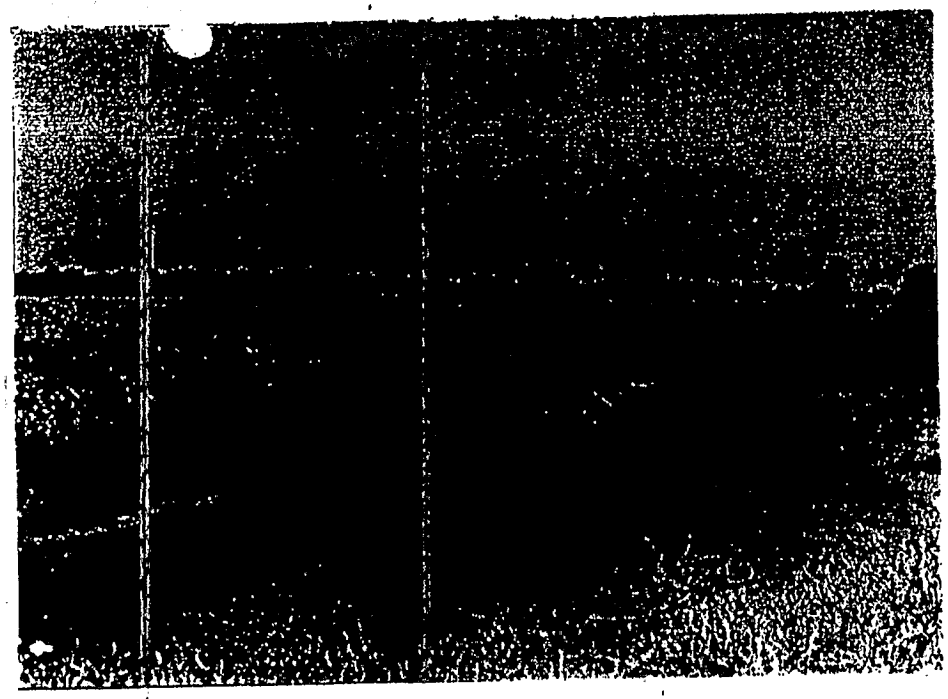


Photo 5

RIVER BANK EROSION

Photo 4 & 5: Erosion on the right bank of the San Joaquin River at river mile 100.8. (Reclamation District No. 2091) (July 1, 1992)

Figure 3



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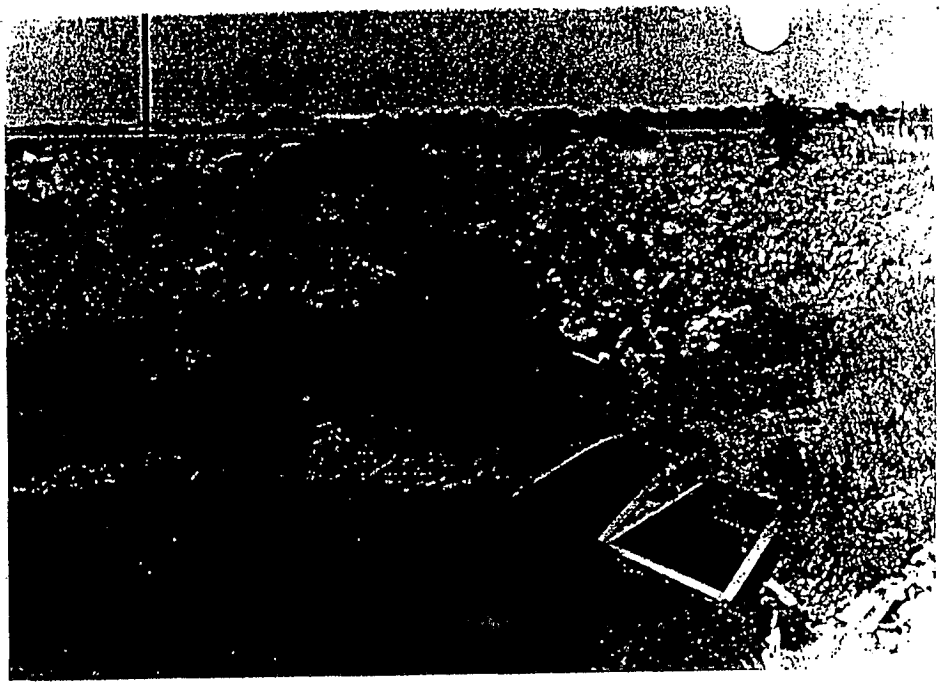

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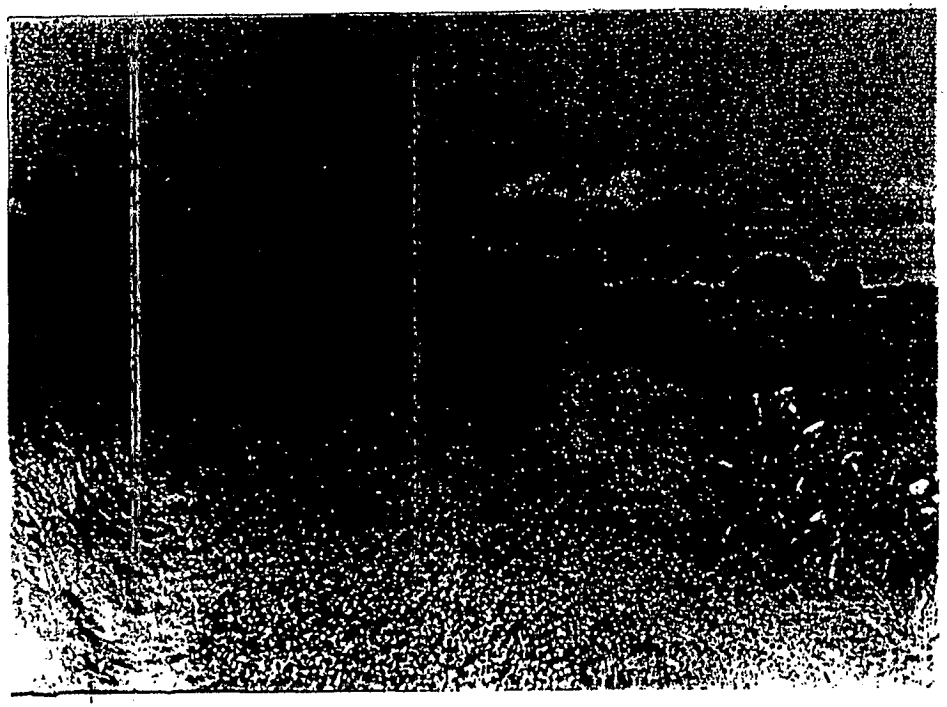

Photo 6

Photo 6: Riverside slope obscured with brush at river mile 109.3 - 109.5 (Reclamation District No. 2063). (July 1, 1992)

Photo 7: Looking downstream along West Stanislaus Main Canal near river mile 84. (Reclamation District No. 2100) (July 1, 1992)

Photo 8: Culverts at the crossing of the West Stanislaus Main Canal (Reclamation District No. 2100) (July 1, 1992)

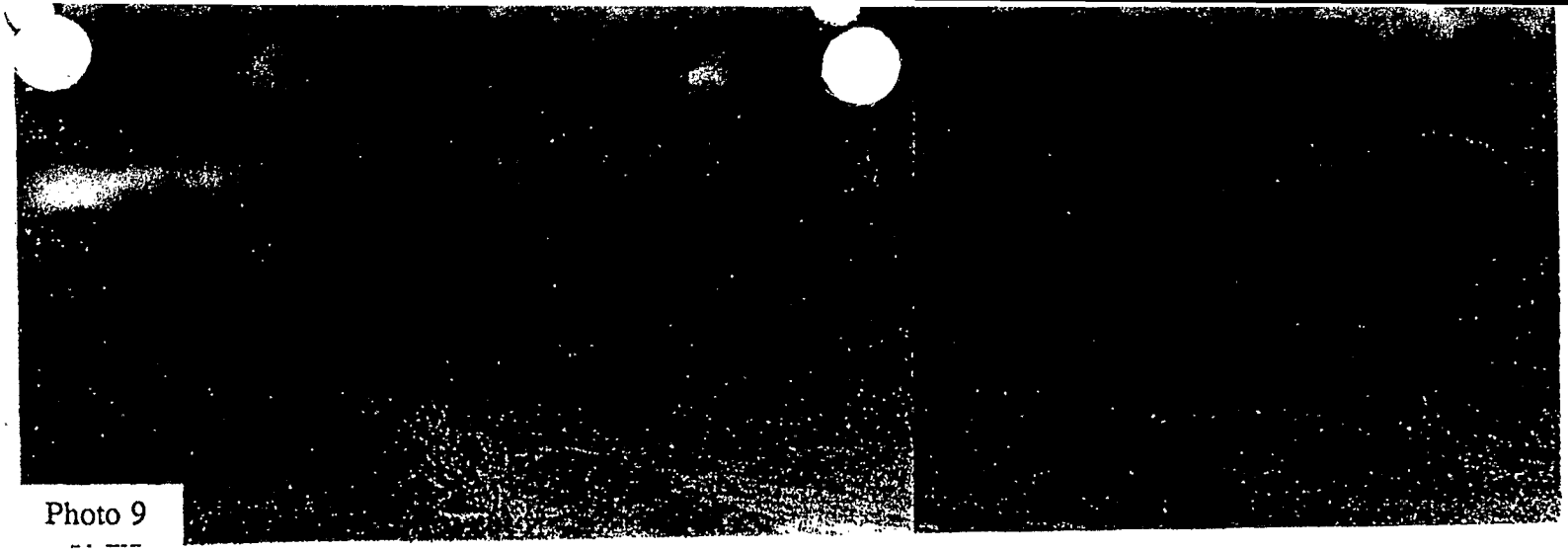

Photo 9

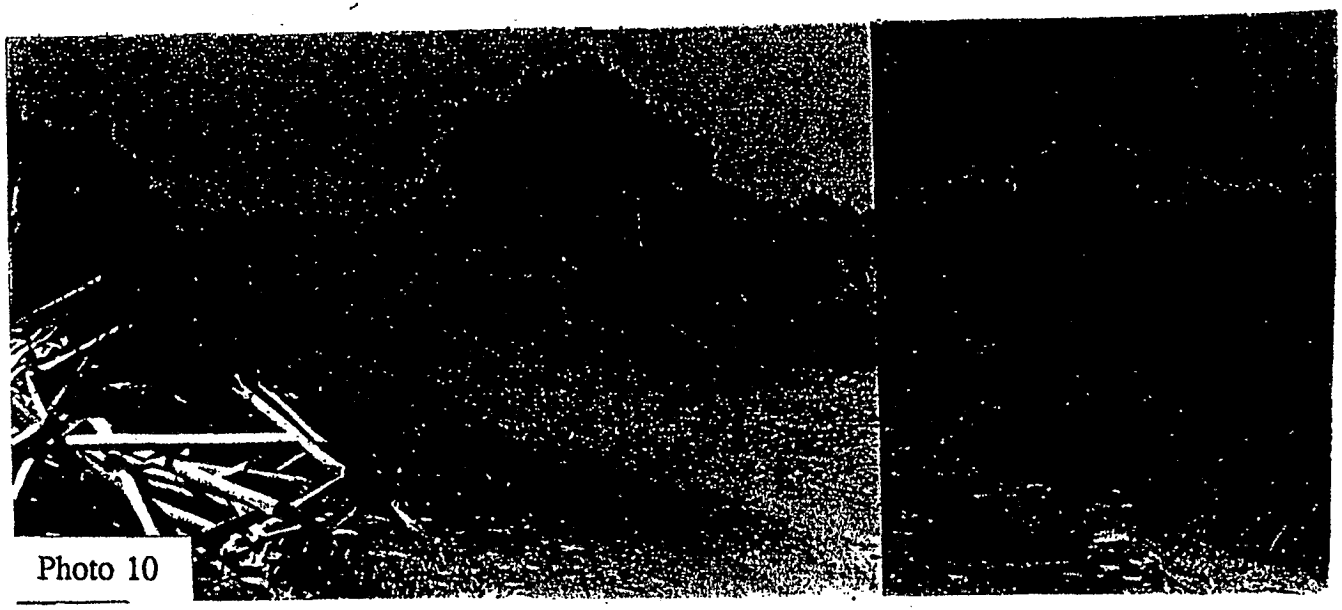

Photo 10

Photo 9 & 10: Looking at the deteriorated levee crown and slope created by ATV vehicles and off road motorcycles on both sides of the levee between river mile 73 - 74.
(Reclamation District No. 2064).
(July 2, 1992)

Figure 5

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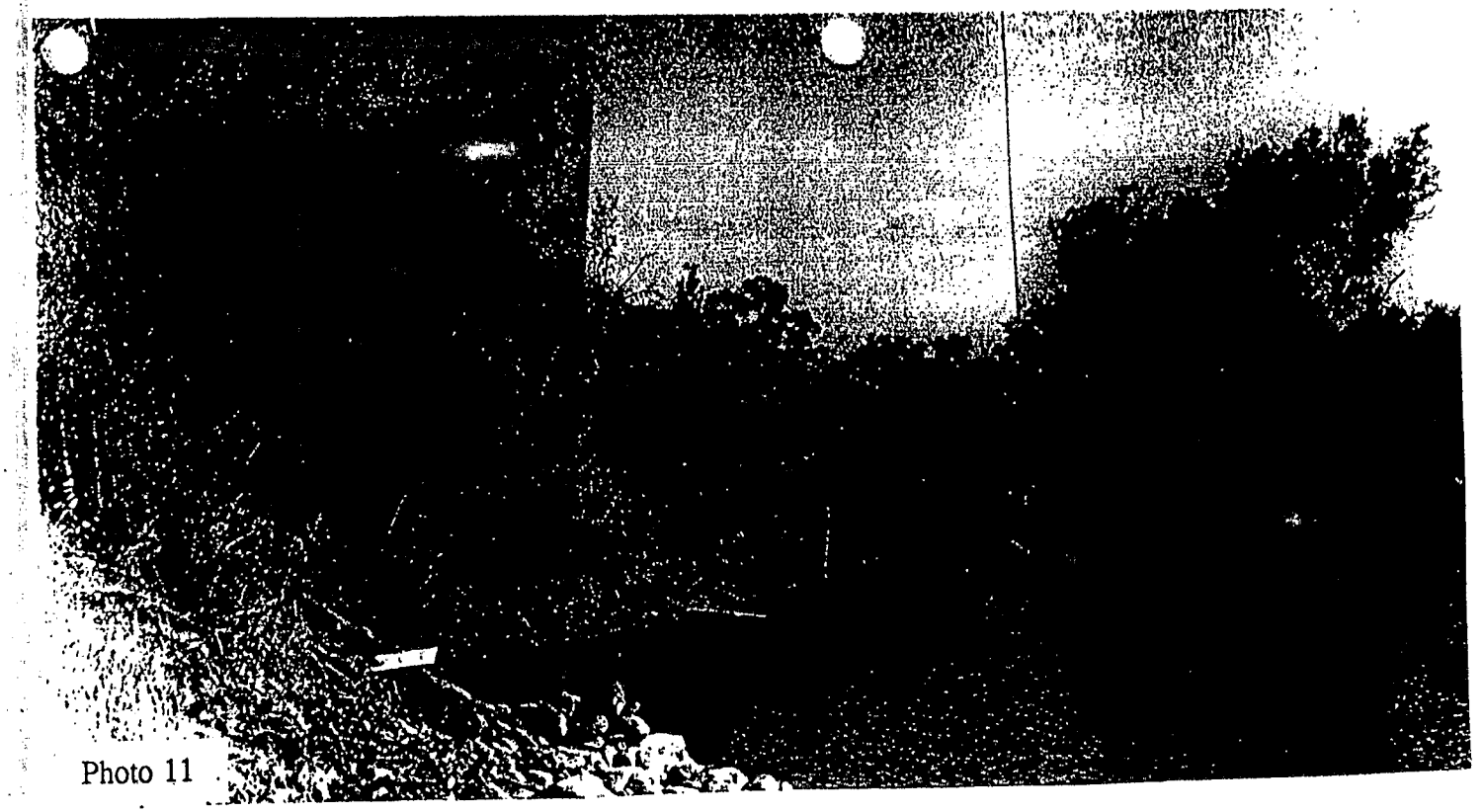


Photo 11

Photo 12

RIVER BANK EROSION

Photo 11: Erosion on the left bank of the San Joaquin River at river mile 70.0 (Reclamation District No. 2091) (June 18, 1992)

Photo 12: Looking across the San Joaquin river at the typical foundation materials, 3'-5' of clay or sandy silt layer underlain by mostly sandy material. (Reclamation District No. 2085) (July 2, 1992)

Figure 6

Photo 13

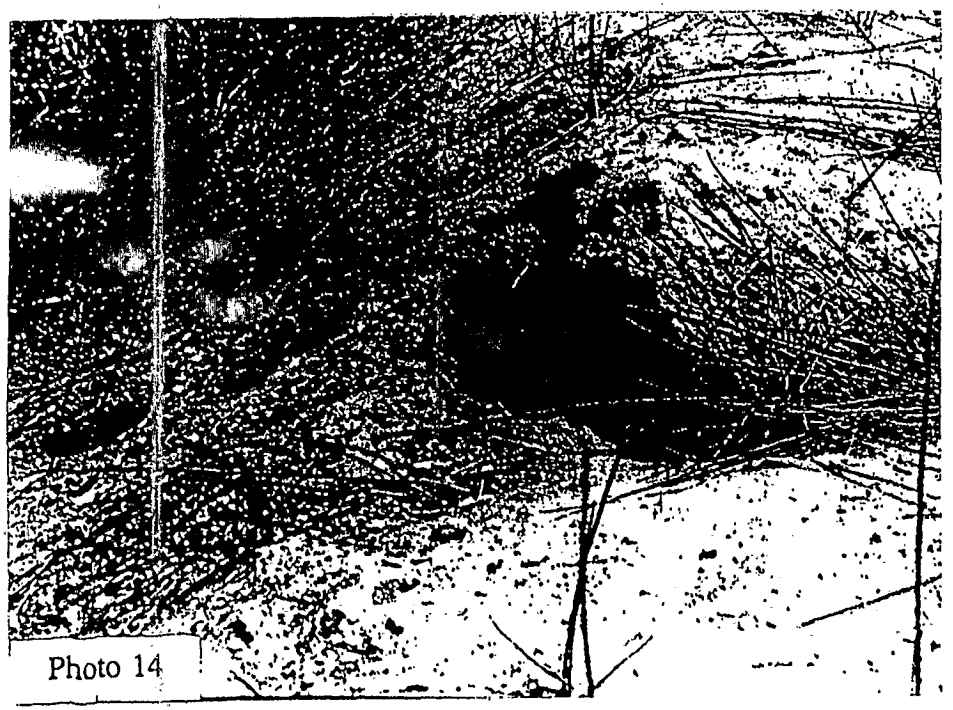


Photo 14

Photo 13 & 14: Levee foundation is cracking and open fissures on the riverside slope at river mile 67.2 (Reclamation District No. 2075). (July 8, 1992)

Figure 7

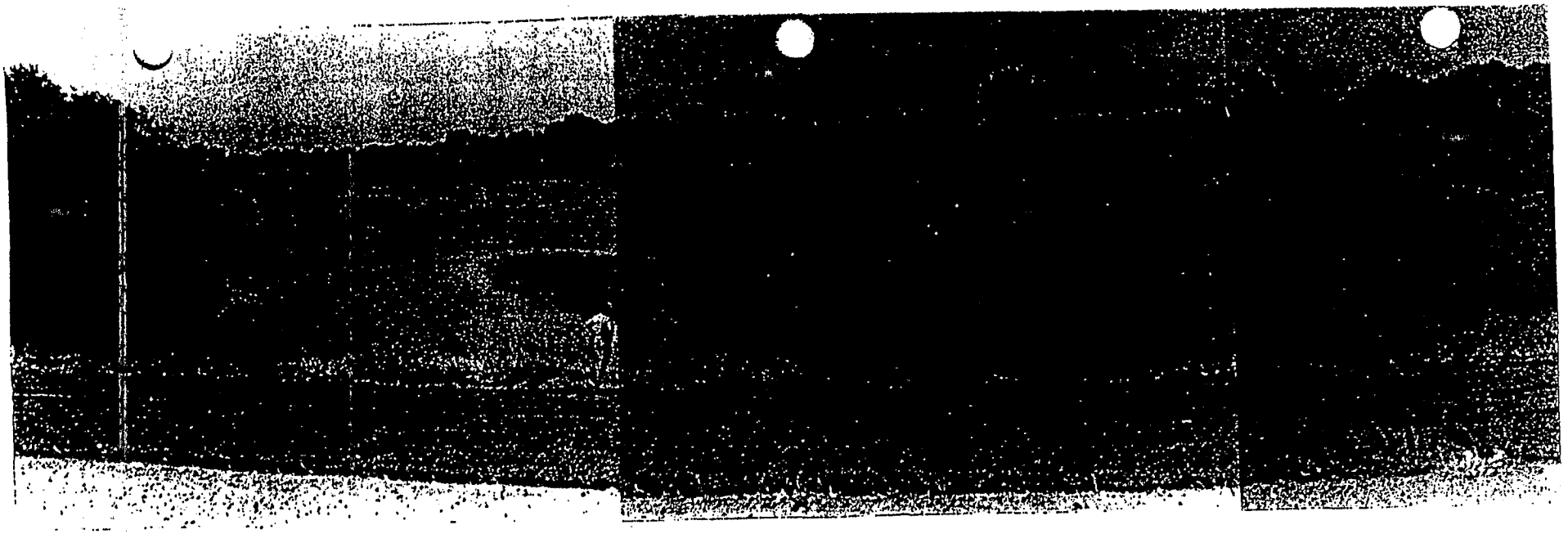


Photo 15

Photo 16

Photo 15: Large area of sand deposition in the San Joaquin River near river mile 60.6 (Reclamation District No. 2094) (July 8, 1992)

Photo 16: Levee landside obscured with trees and brush near river mile 62.1 (Reclamation District No. 2075) (July 8, 1992)

Figure 8

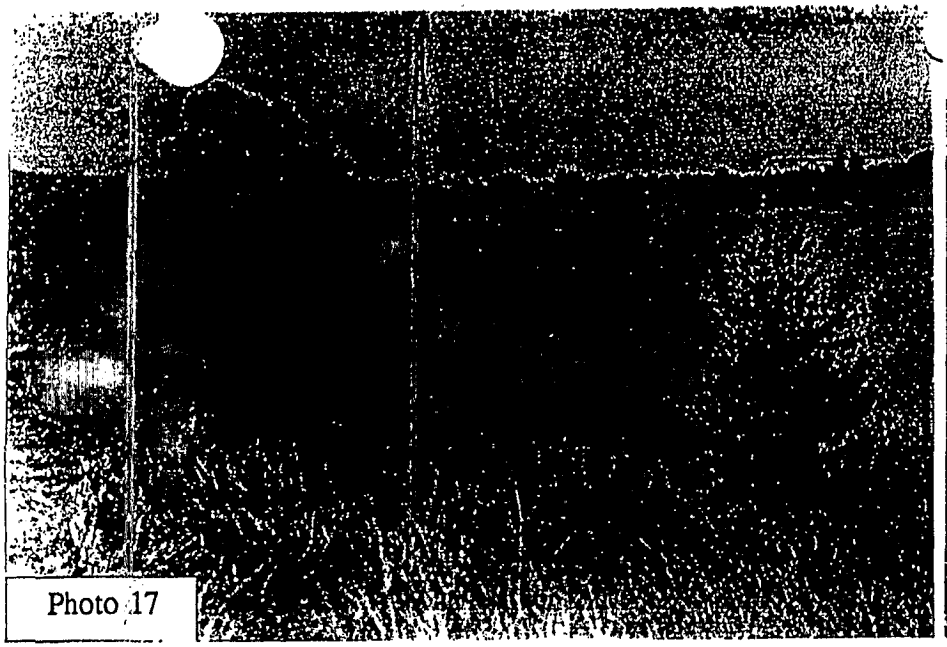


Photo 17: Erosion on the right bank of the San Joaquin River near river mile 56.5 (Reclamation District No. 17) (July 8, 1992)

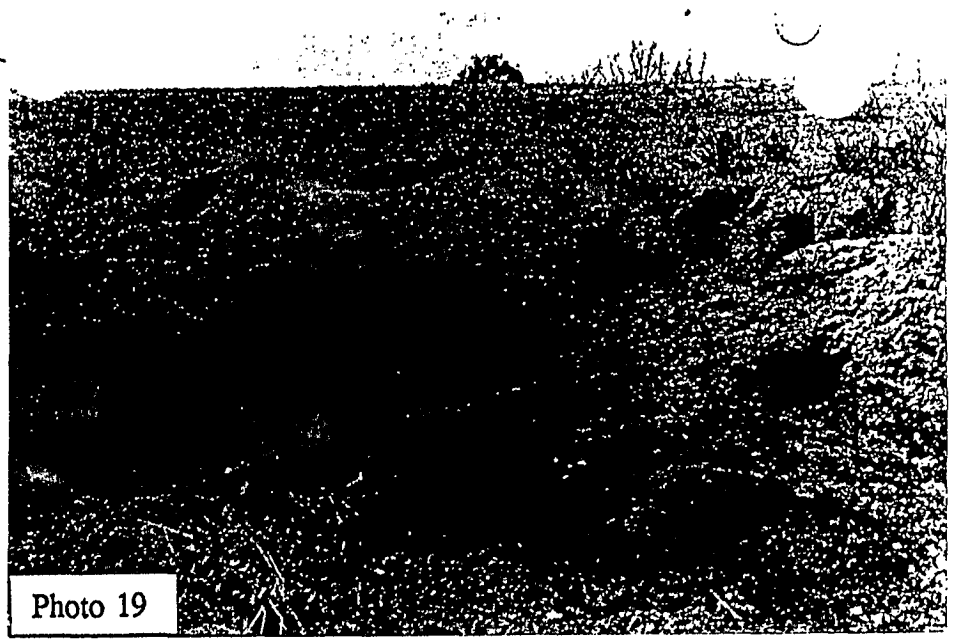


Photo 19: Numerous large rodent holes on both sides of the levee between river mile 57.5 - 57.8. (Reclamation District No. 2094) (July 8, 1992)

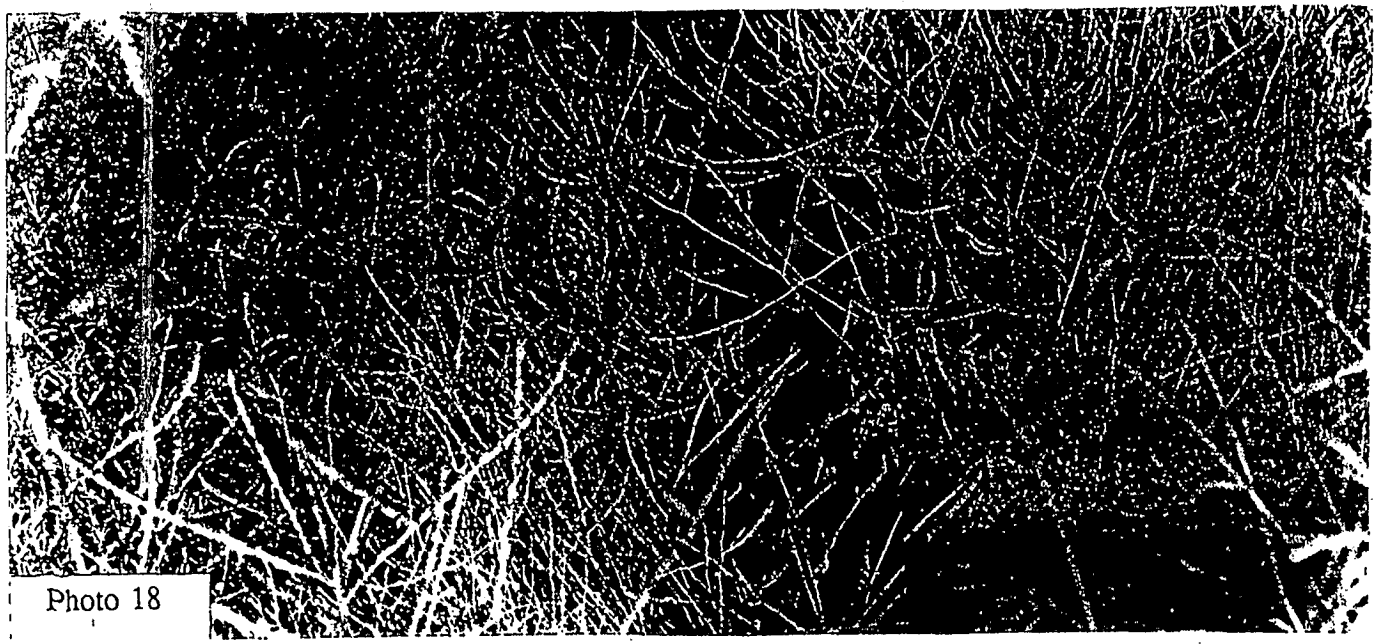


Photo 18: Erosion on the right bank of the San Joaquin River near river mile 60.2. (Reclamation District No. 2094) (July 8, 1992)

Figure 9

Photo 20

Photo 21

Photo 20: Levee erosion on the land side slope near river mile 60.5 (Reclamation District No. 2095) (June 18, 1992)

Photo 21: Levee erosion on the land side slope near river mile 60.8 (Reclamation District No. 2095) (June 18, 1992)

Figure 10

Photo 22

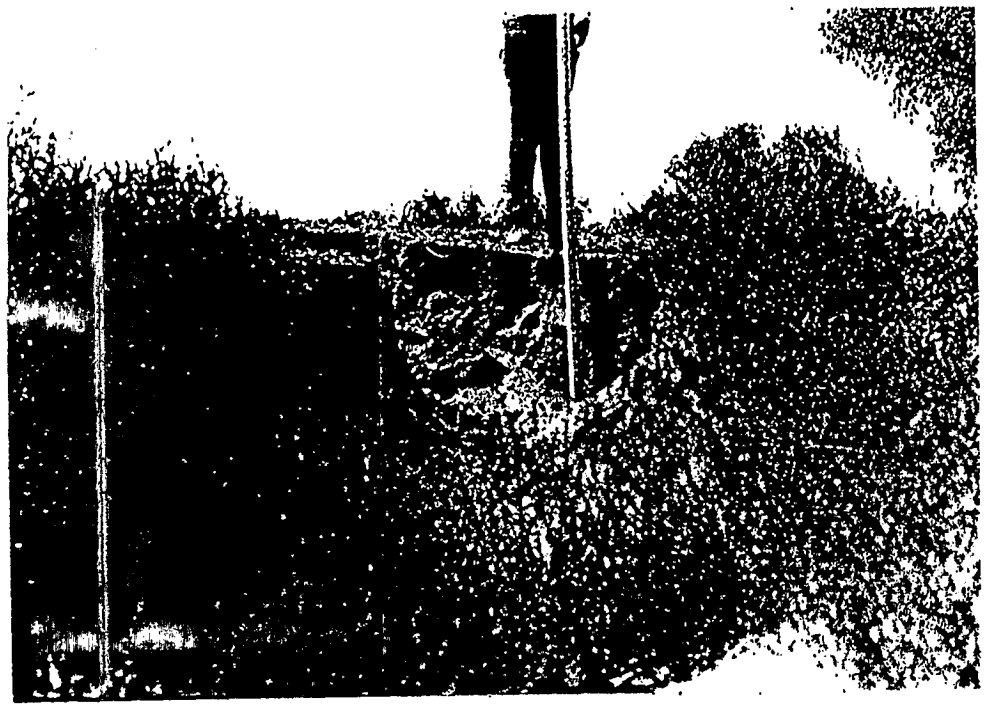


Photo 23

Photo 22: Levee erosion on the land side slope near river mile 60.7 (Reclamation District No. 2095) (June 18, 1992)

Photo 23: Levee erosion on the land side slope near river mile 60.6 (Reclamation District No. 2095) (June 18, 1992)

Figure 11

Photo 24

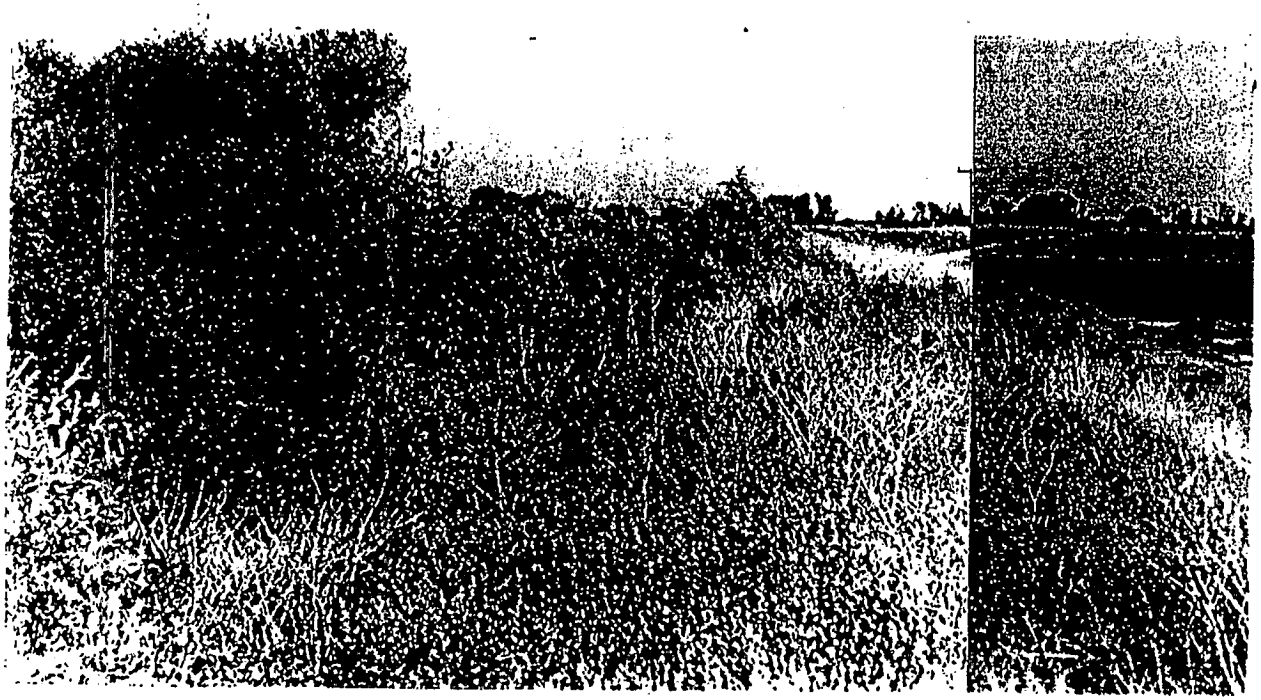


Photo 25

Photo 24: Looking at the deteriorated levee crown and slope created by ATV vehicles and off road motorcycles near river mile 62.7. (Reclamation District No. 2095). (June 18, 1992)

Photo 25: Levee and riverside slope totally obscured with trees and brush near river mile 62.2 (Reclamation District No. 2095) (June 18, 1992)

Photo 27

Photo 28

Photo 26

Photo 27 & 28: Levee erosion on the river side slope near river mile 55.0 (Reclamation District No. 2062) (June 18, 1992)

Photo 26: Erosion on the left bank of the San Joaquin River near river mile 53.8. (Reclamation District No. 2062) (June 18, 1992)

Figure 13

C-104615

C-104615

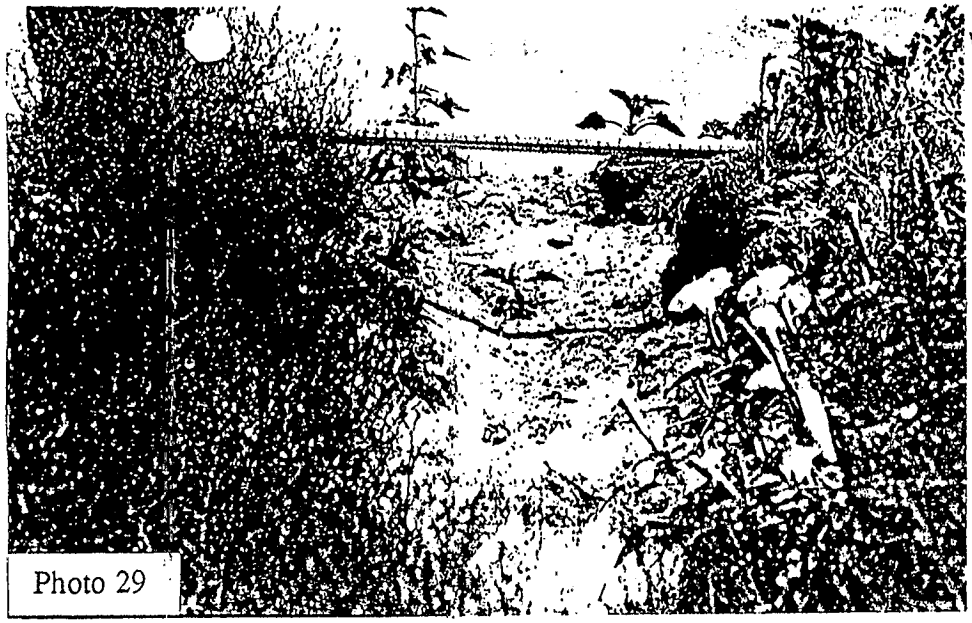


Photo 29

Photo 30

Photo 31

Photo 32

Photo 29 & 30: Levee erosion on the land side slope near river mile 54.1 (Reclamation District No. 2062), (June 18, 1992)

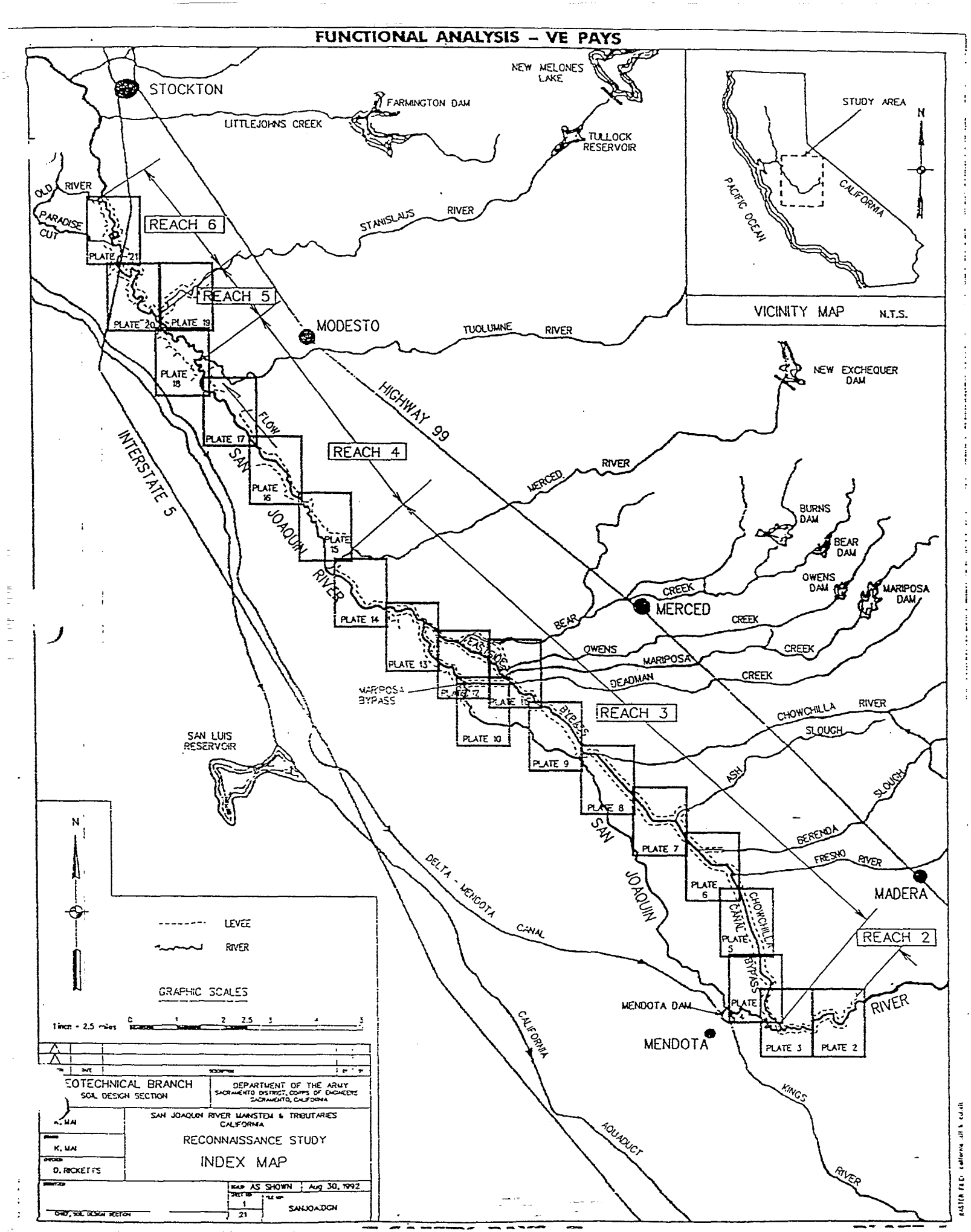
Photo 31 & 32: Levee erosion on the land side slope near river mile 54.7 (Reclamation District No. 2[illegible] (June 18, 1992)

Figure 14

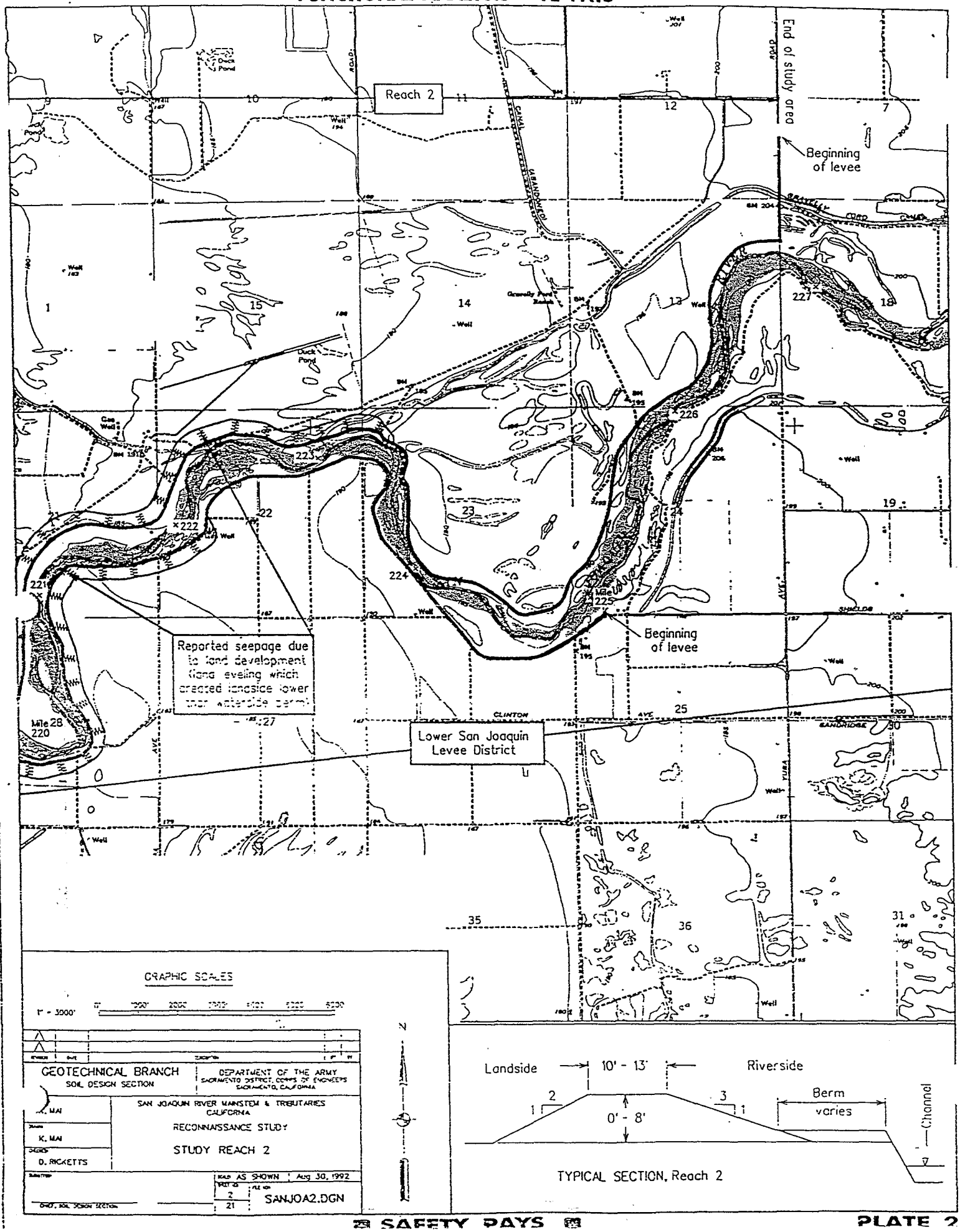
RECONNAISSANCE REPORT
SAN JOAQUIN RIVER MAINSTEM, CALIFORNIA

PLATES

FUNCTIONAL ANALYSIS – VE PAYS



C – 1 0 4 6 1 8



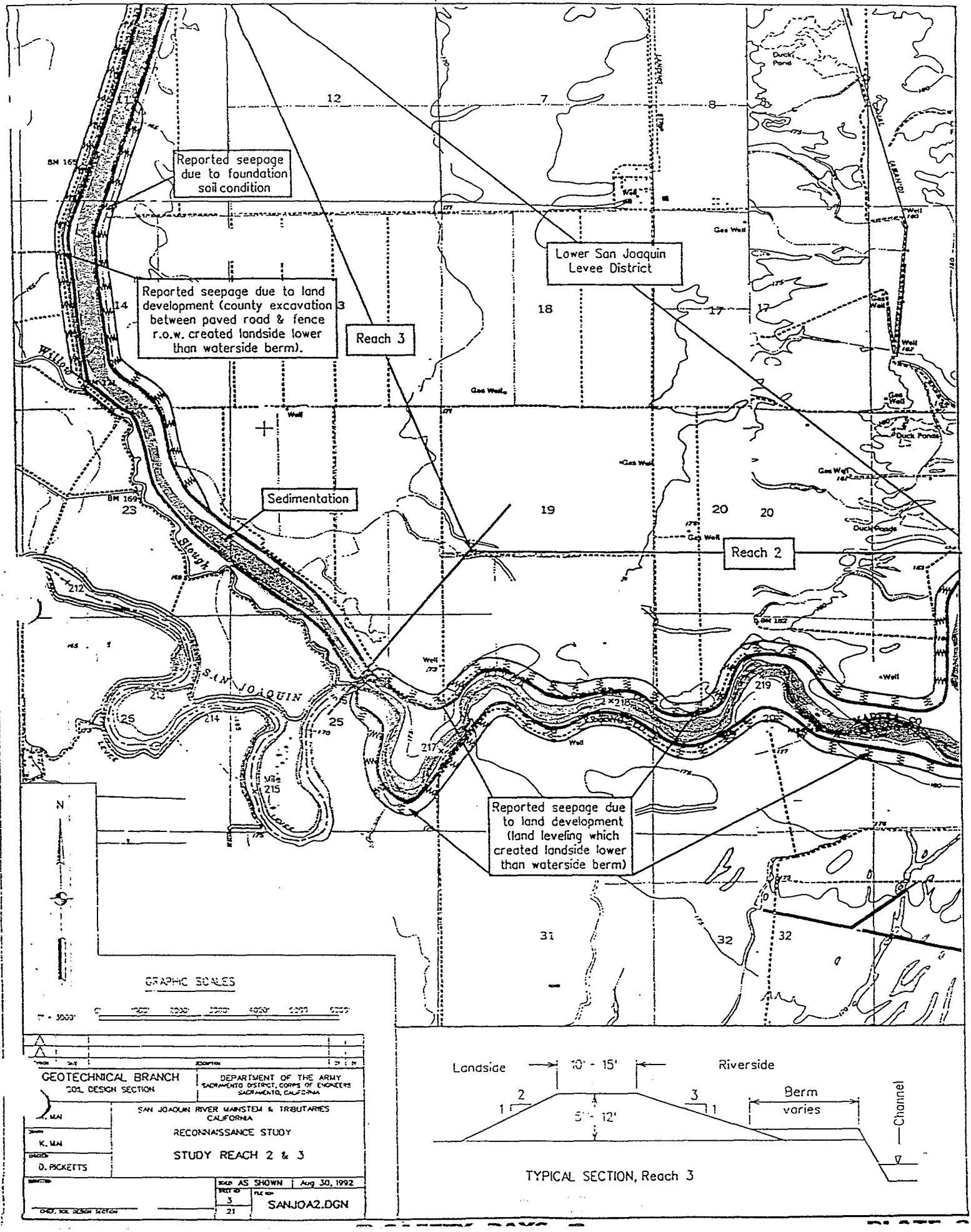
SAFETY PAYS

PLATE 2

C – 1 0 4 6 1 9

C-104619

FUNCTIONAL ANALYSIS – VE PAYS



C-104620

C-104620

FUNCTIONAL ANALYSIS – VE PAYS

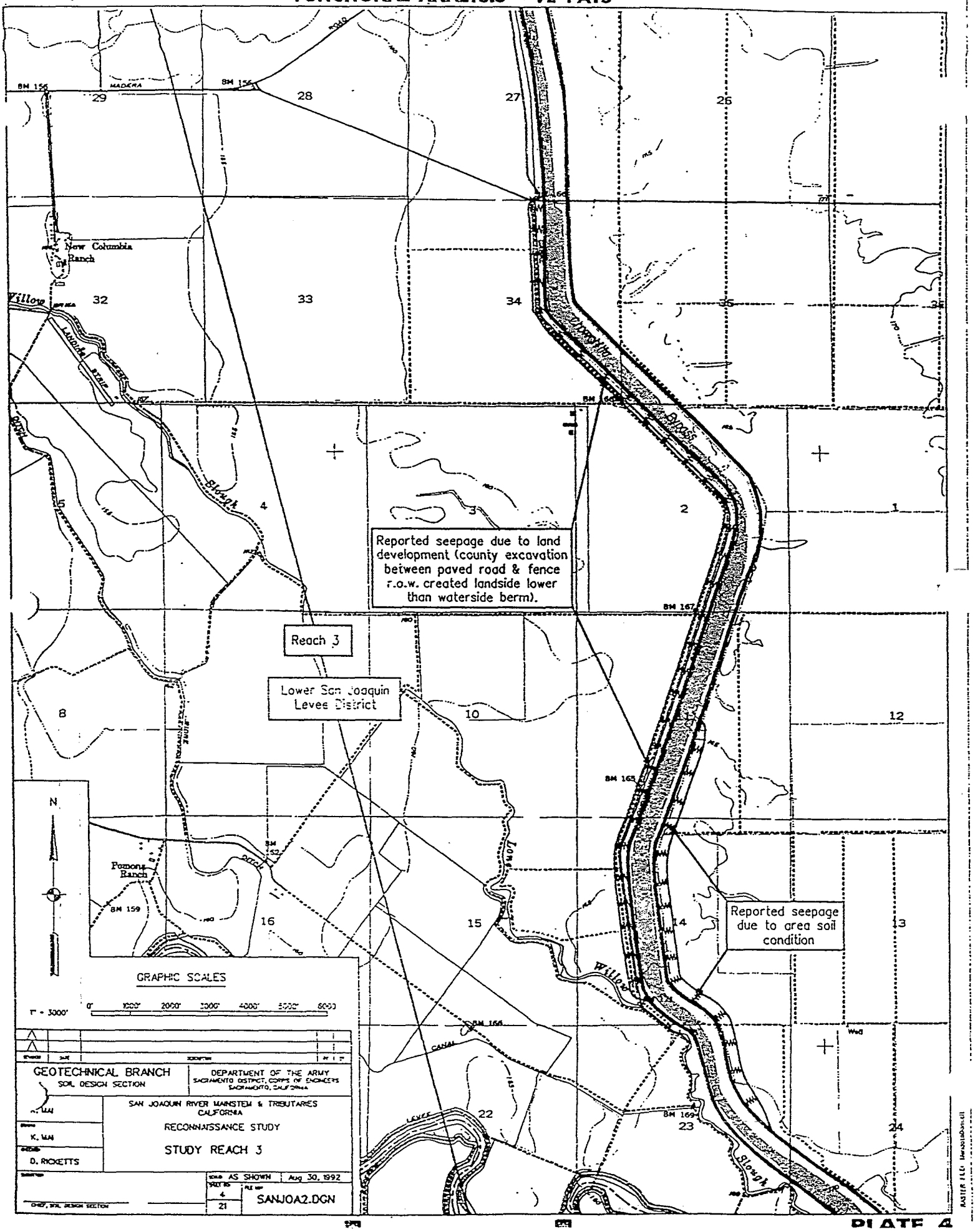
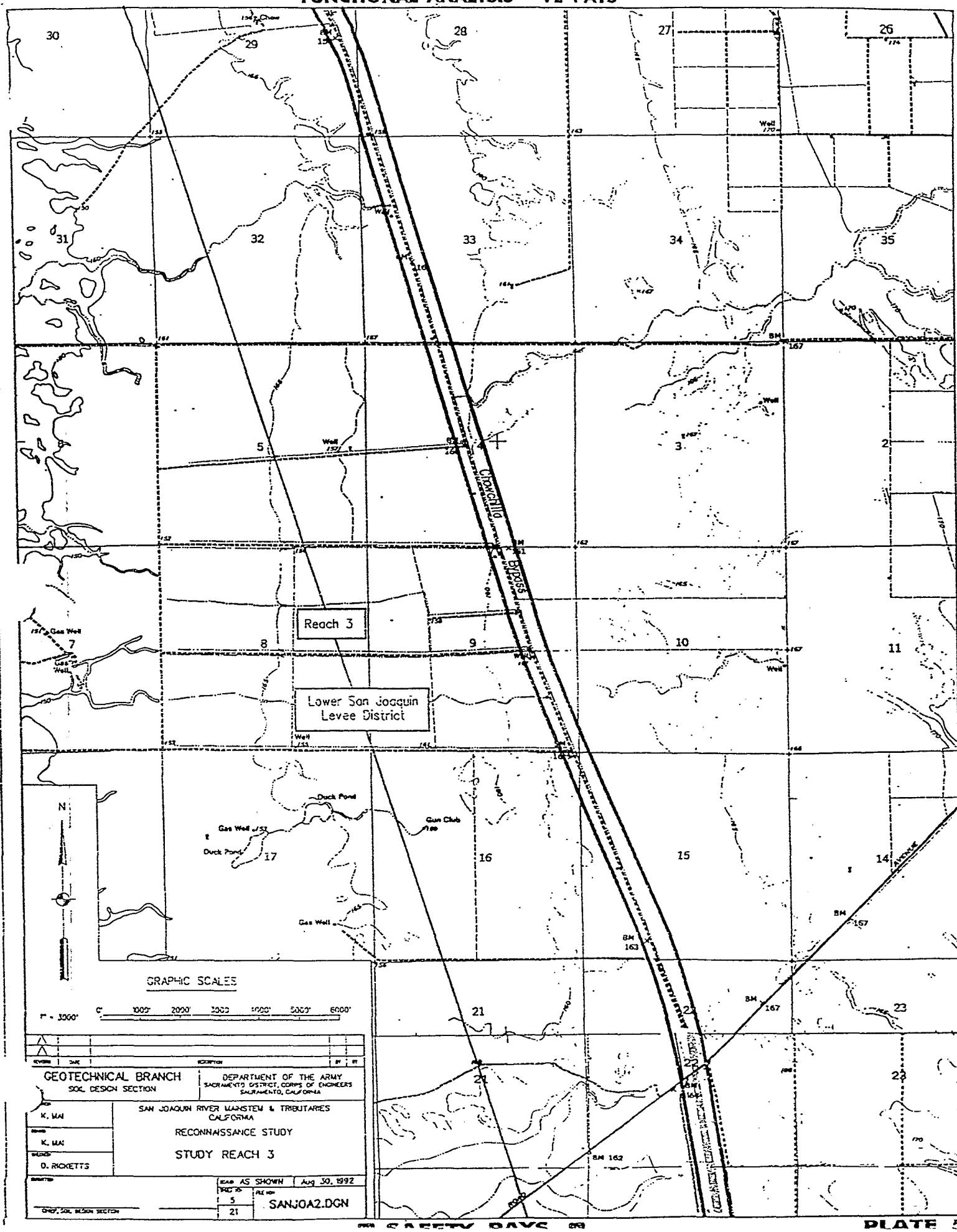


PLATE 4

C-104621

C-104621



GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

K. MAI
K. MAI
D. RICKETTS

SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA
RECONNAISSANCE STUDY
STUDY REACH 3

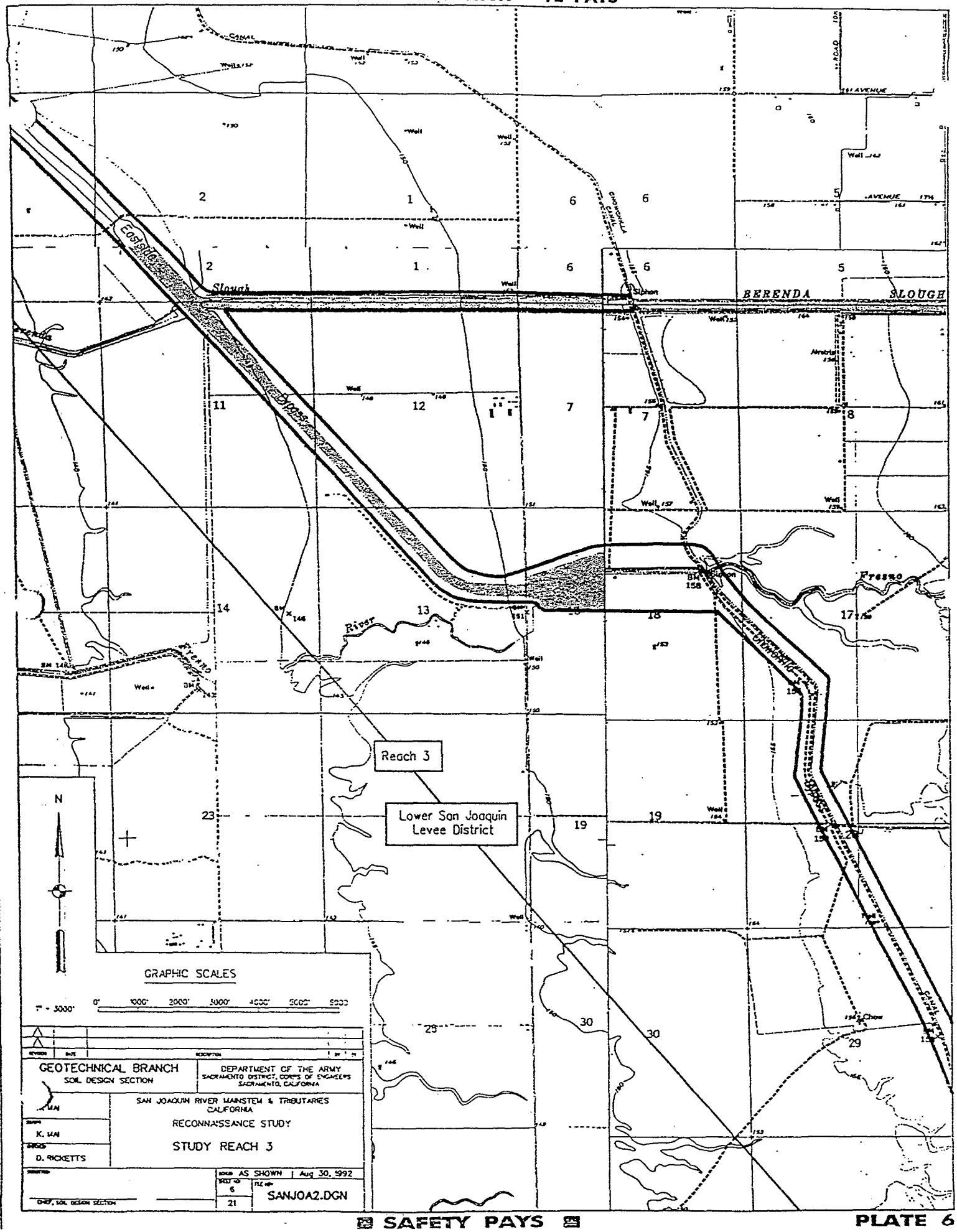
SCALE AS SHOWN | Aug 30, 1992
SHEET NO. 5 of 21
FILE NO. SANJOA2.DGN

SAFETY DAYS

PLATE 5

C – 1 0 4 6 2 2

FUNCTIONAL ANALYSIS – VE PAYS



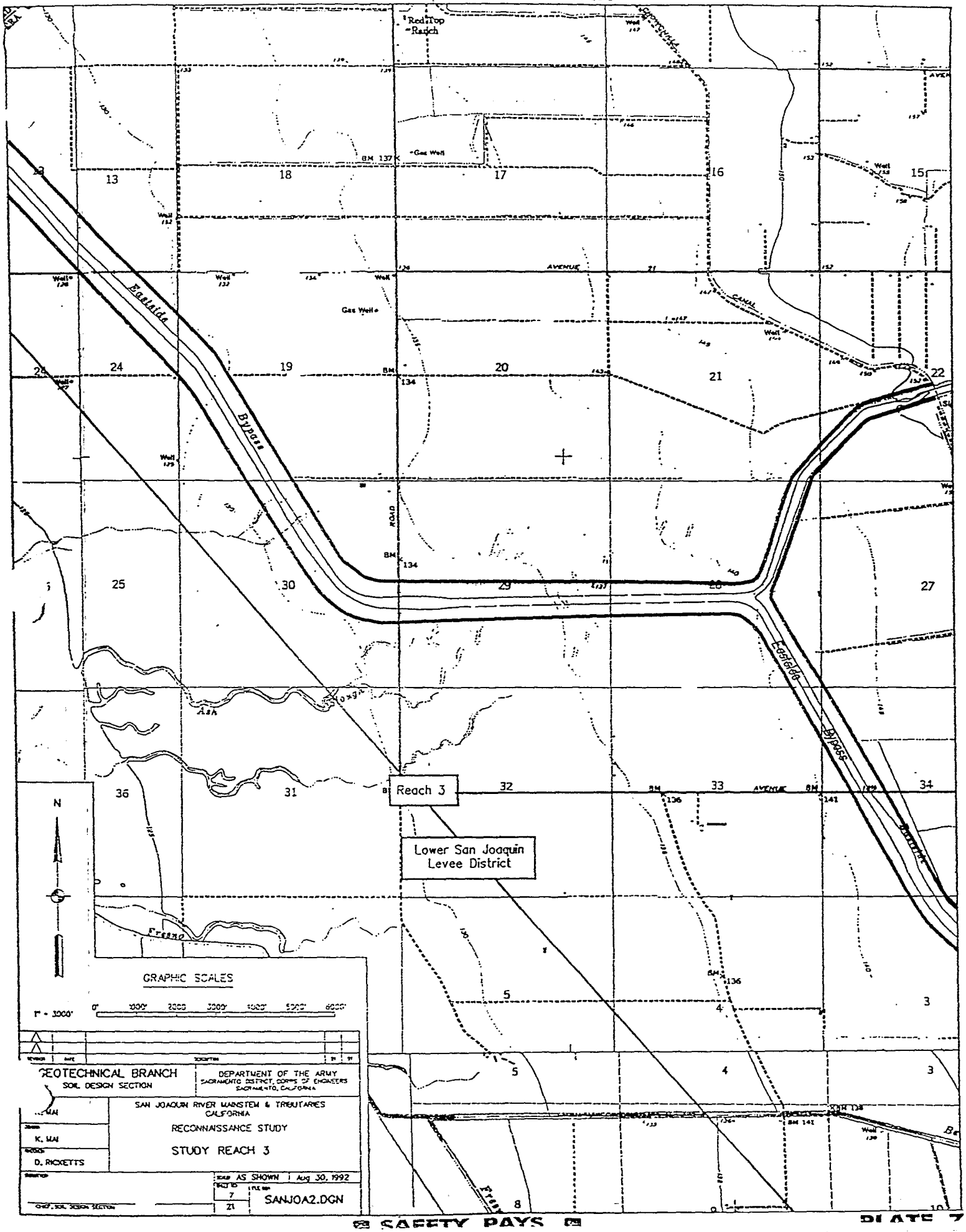
SAFETY PAYS

PLATE 6

C – 1 0 4 6 2 3

C-104623

FUNCTIONAL ANALYSIS – VE PAYS



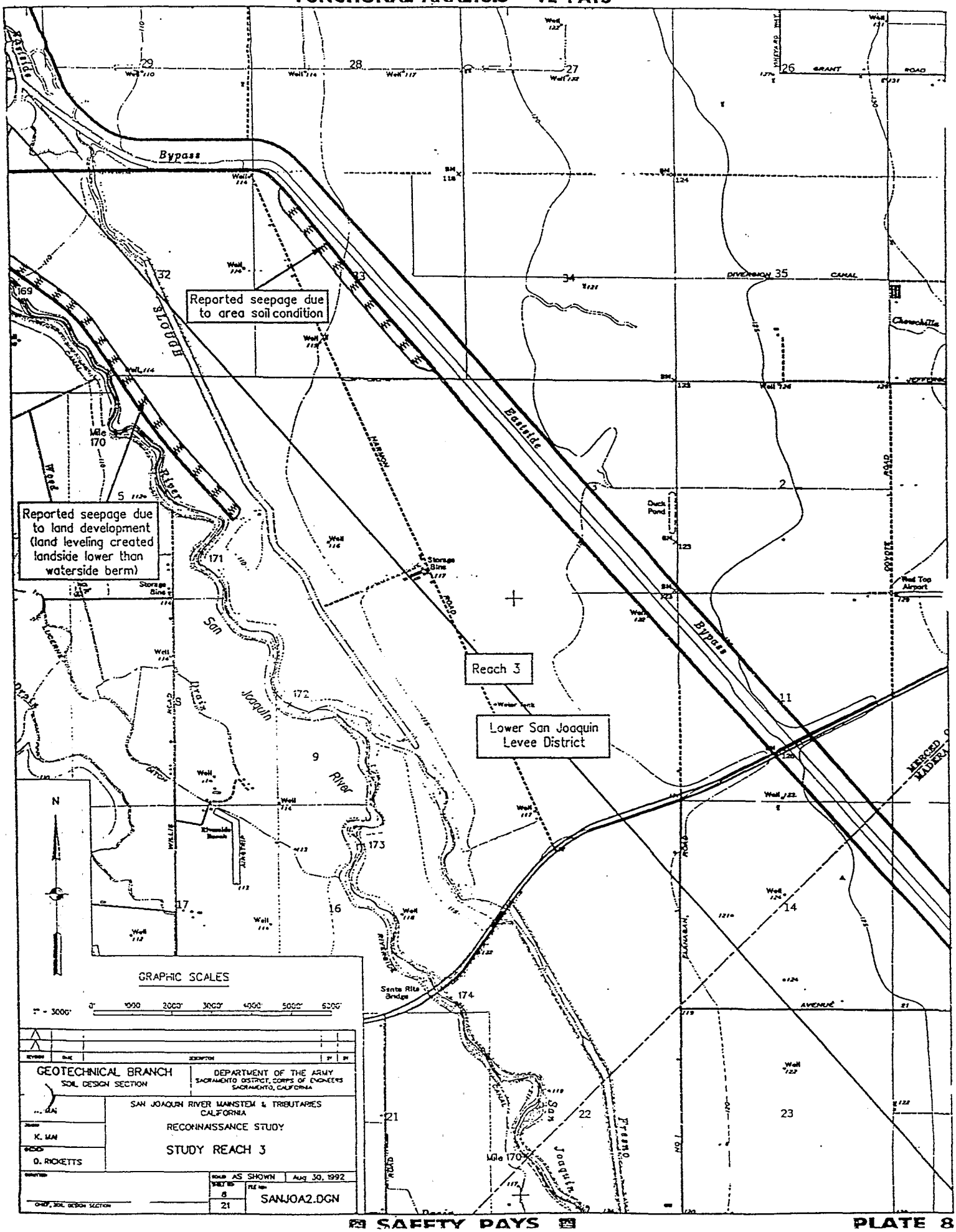
SAFETY PAYS

PLATE 7

C – 1 0 4 6 2 4

C-104624

FUNCTIONAL ANALYSIS – VE PAYS

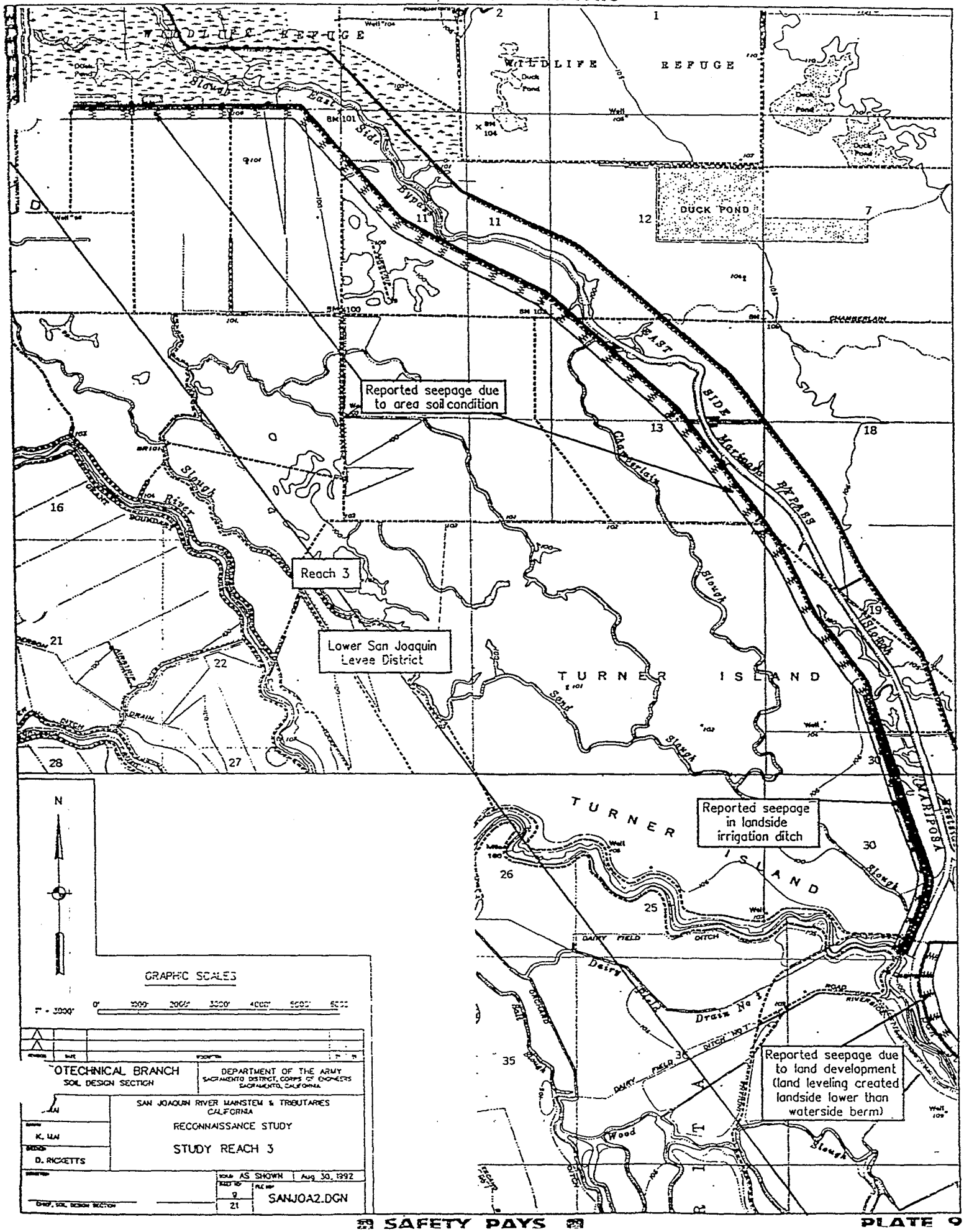


SAFETY PAYS

PLATE 8

C-104625

C-104625



GEOTECHNICAL BRANCH SOIL DESIGN SECTION	DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
	SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES CALIFORNIA RECONNAISSANCE STUDY STUDY REACH 3
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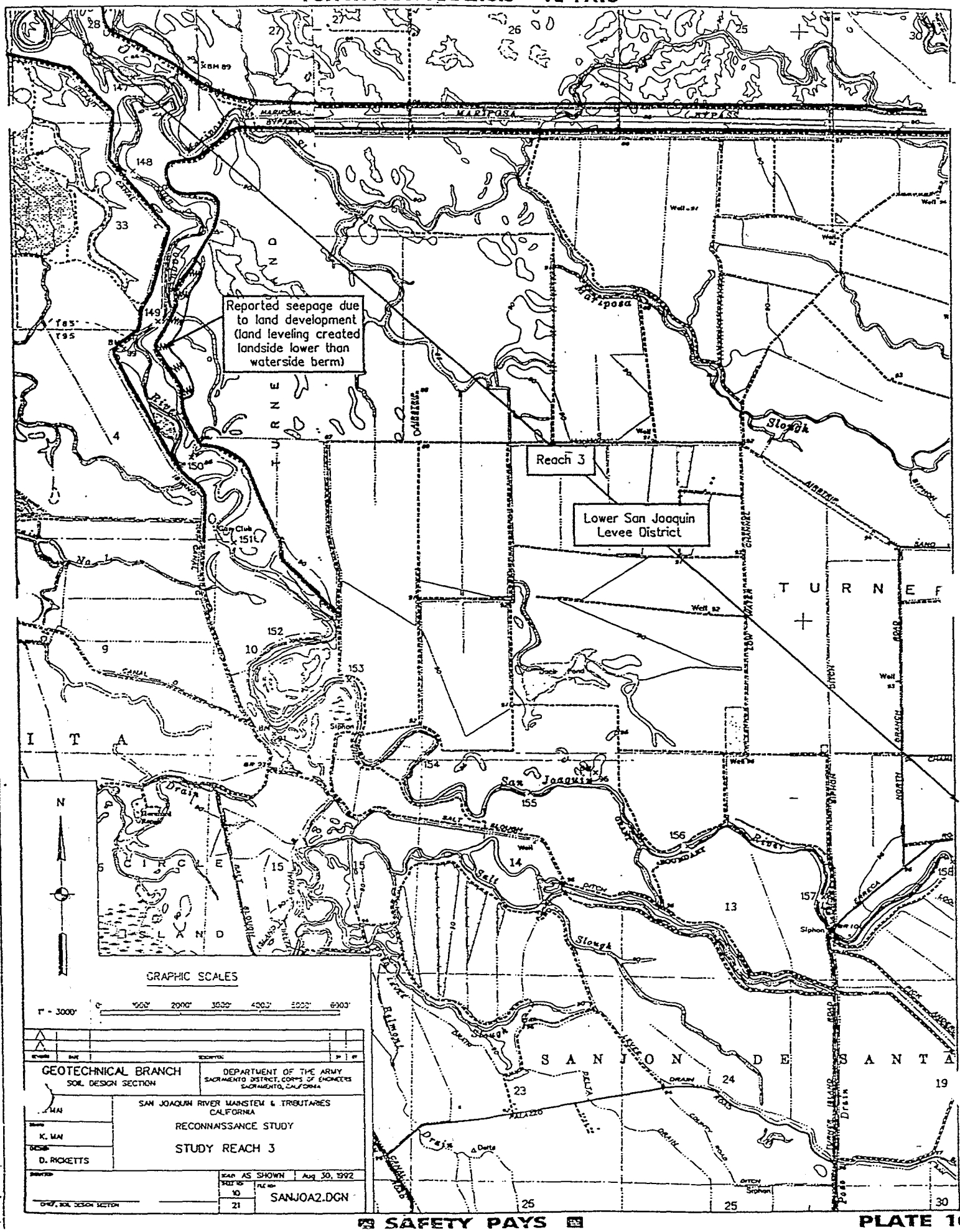
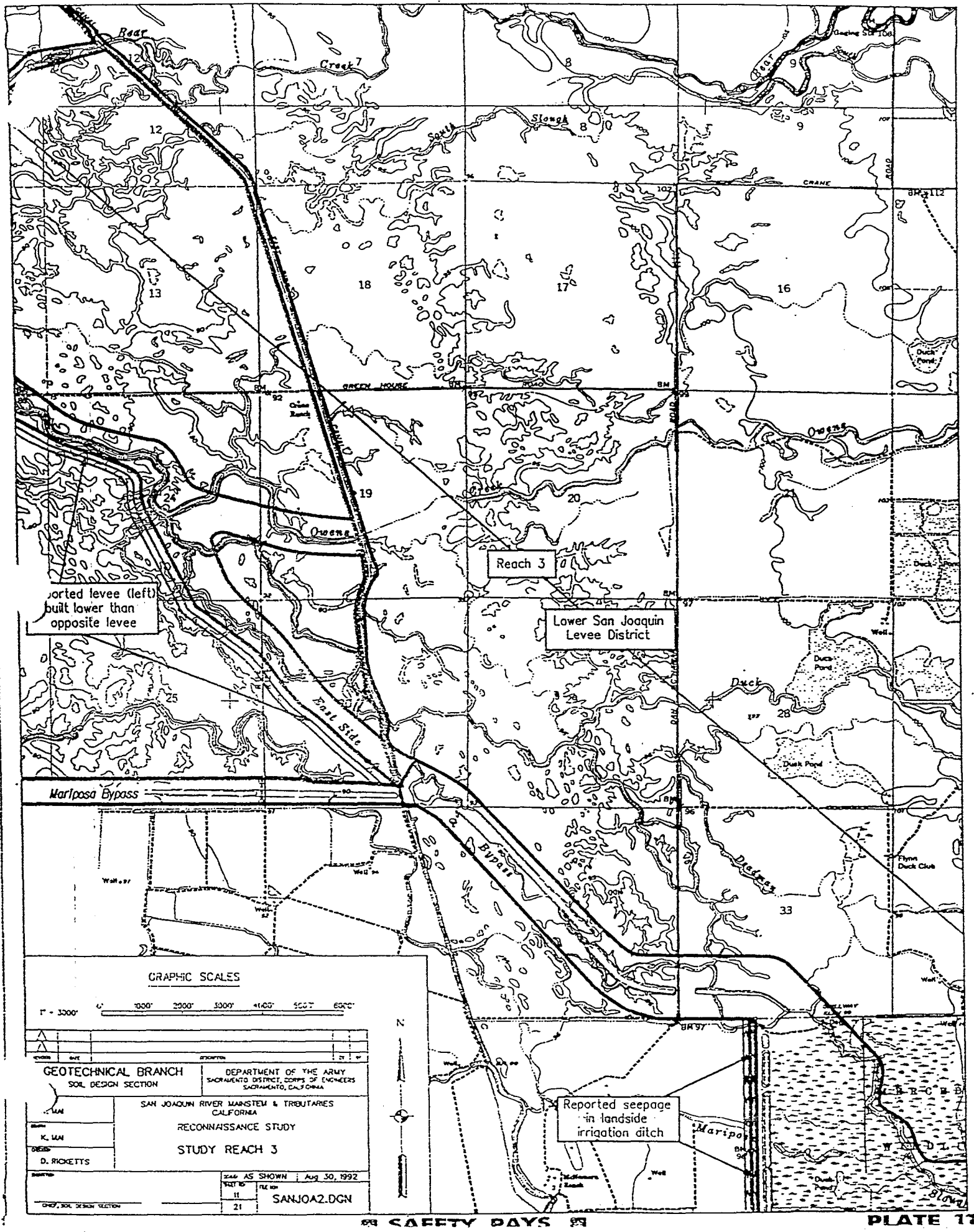


C—104627

C-104627

FUNCTIONAL ANALYSIS – VE PAYS

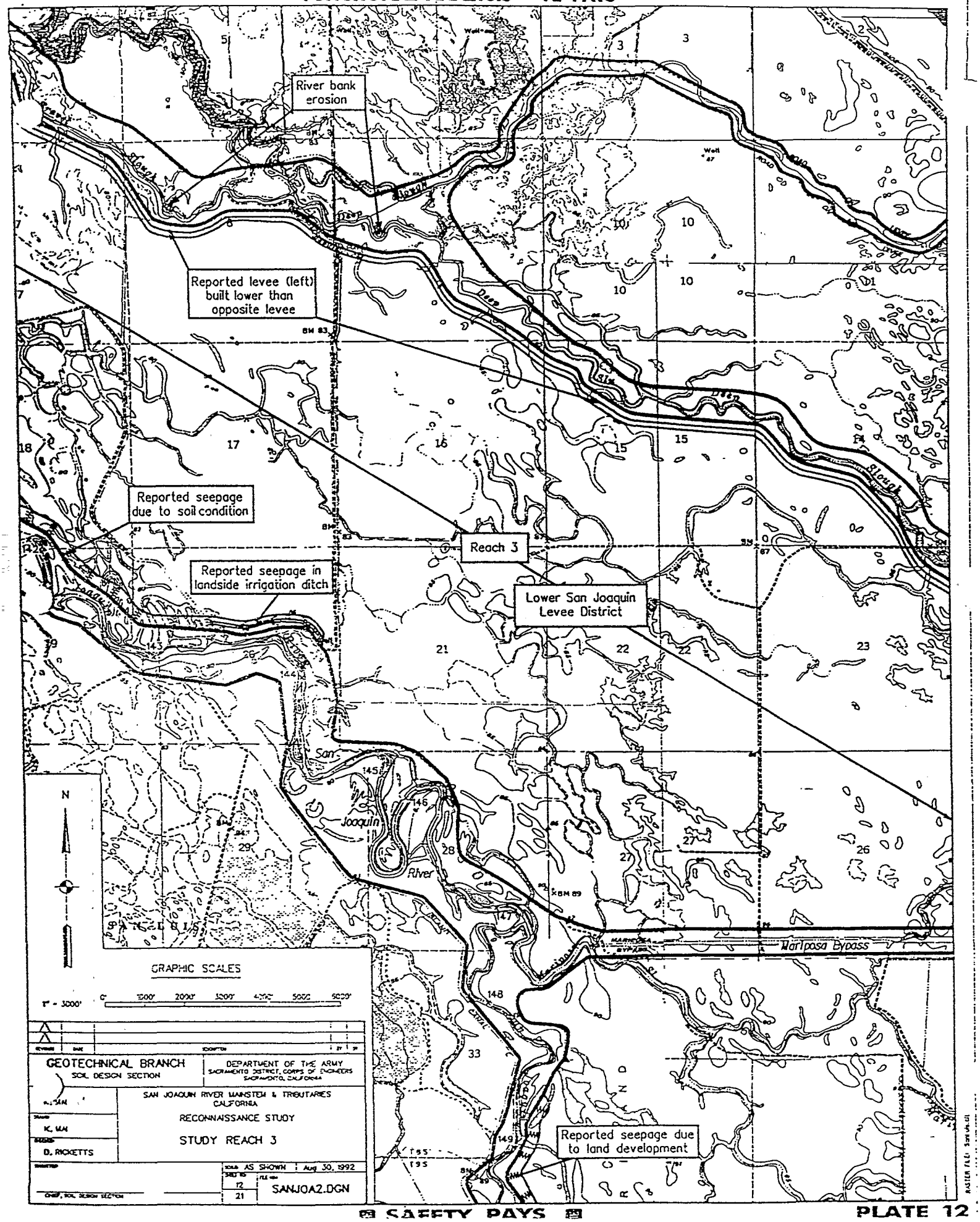


SAFETY DAYS

PLATE 11

C-104628

C-104628



GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

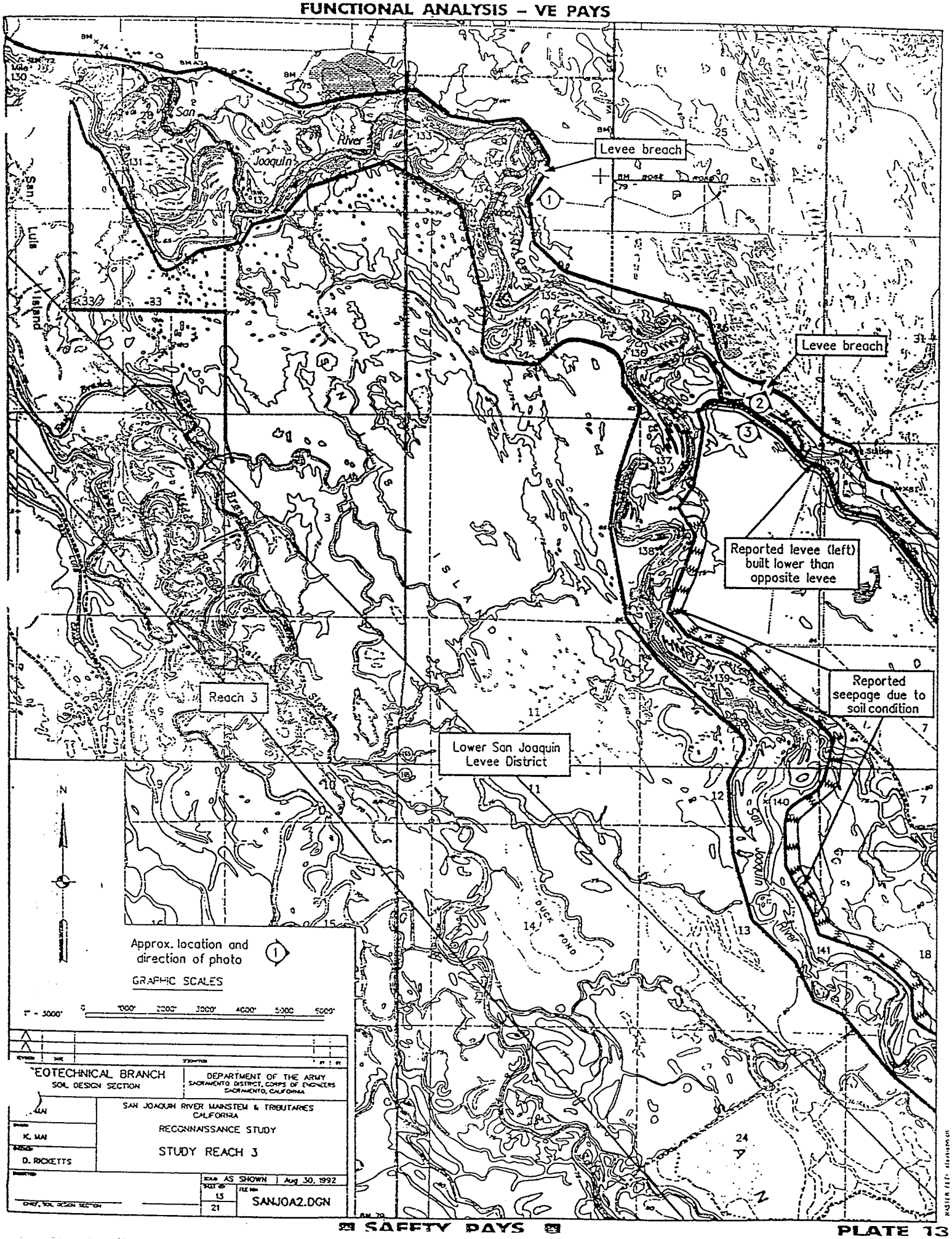
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

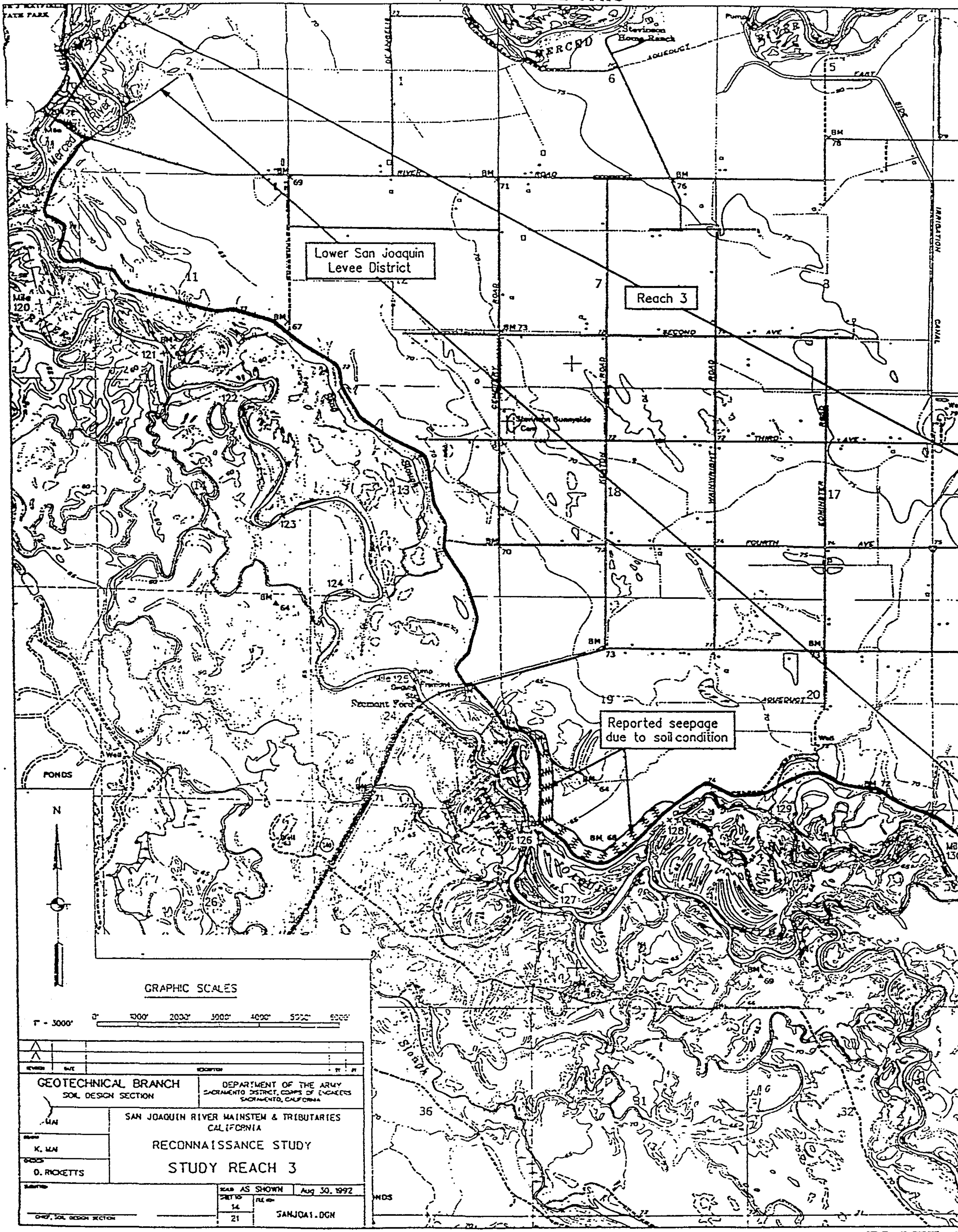
SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA
RECONNAISSANCE STUDY
STUDY REACH 3

K. MAN
D. RICKETTS

SCALE AS SHOWN | Aug 30, 1992
SHEET NO. 12
21
FILE NAME SANJOA2.DGN

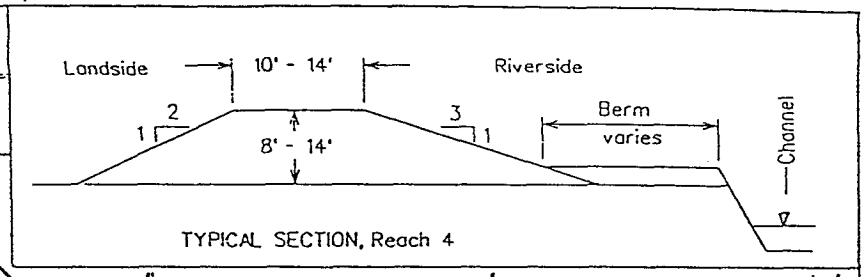
C-104629


Levee breach
Levee breach
Reported levee (left) built lower than opposite levee
Reported seepage due to soil condition
Reach 3
Lower San Joaquin Levee District
San Joaquin River
San Luis Island
Approx. location and direction of photo
GRAPHIC SCALES
1" = 3000'
0
1000'
2000'
3000'
4000'
5000'
6000'
GEOTECHNICAL BRANCH
SOIL DESIGN SECTION
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA
RECONNAISSANCE STUDY
STUDY REACH 3
K. MAI
D. RICKETTS
AS SHOWN
Aug 30, 1992
13
21
SANJOA2.DGN


Lower San Joaquin
Levee District
Reach 3
Reported seepage
due to soil condition
Merced River
Stevinson Home Ranch
SECOND AVE
THIRD AVE
FOURTH AVE
CEMETERY ROAD
WAINWRIGHT ROAD
IRRIGATION CANAL
PONDS
GRAPHIC SCALES
1" = 3000'
0' 1000' 2000' 3000' 4000' 5000' 6000'
GEOTECHNICAL BRANCH
SOIL DESIGN SECTION
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA
RECONNAISSANCE STUDY
STUDY REACH 3
K. LAI
D. RICKETTS
AS SHOWN
Aug 30, 1992
14
21
SANJOA1.DGN

C-104631

FUNCTIONAL ANALYSIS – VE PAYS



TYPICAL SECTION, Reach 4

Seepage

Vegetation overgrowth

R.D. 2063

Reach 4

Reach 3

Approx. location and direction of photo (1)

GRAPHIC SCALES

1" = 3000'

GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

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CALIFORNIA

RECONNAISSANCE STUDY

STUDY REACH 4

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AS SHOWN | Aug 30, 1992

15

21

SANJOA1.DGN

CHIEF, SOIL DESIGN SECTION

SACRAMENTO RIVER

SAN JOAQUIN RIVER

ORESTIMBA CREEK

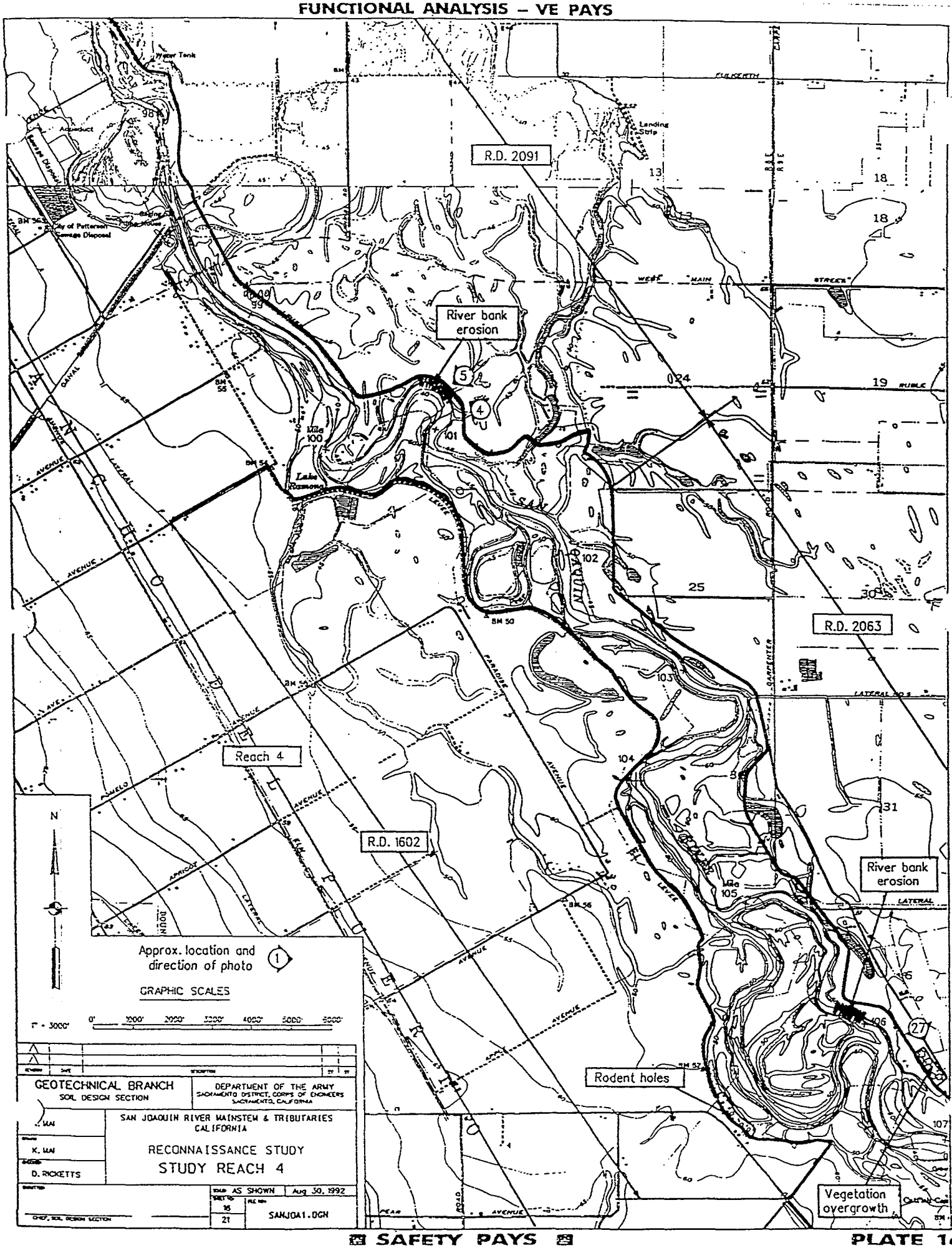
MARSHALL CREEK

DEL PUERTO CREEK

CROW CREEK

PLATE 15

C-104632


R.D. 2091
River bank erosion
R.D. 2063
Reach 4
R.D. 1602
River bank erosion
Rodent holes
Vegetation overgrowth
Approx. location and direction of photo
GRAPHIC SCALES
GEOTECHNICAL BRANCH
SOIL DESIGN SECTION
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
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CALIFORNIA
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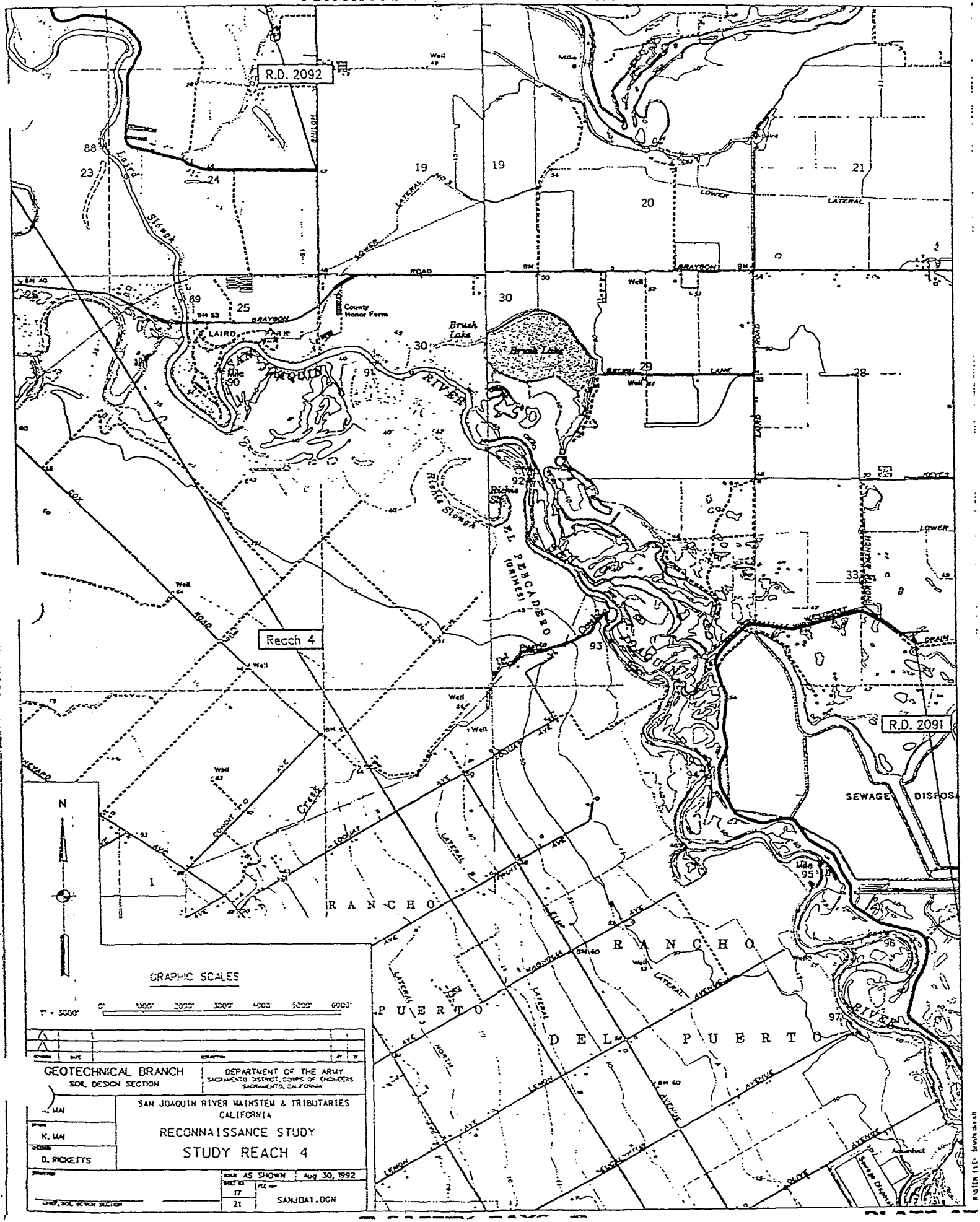
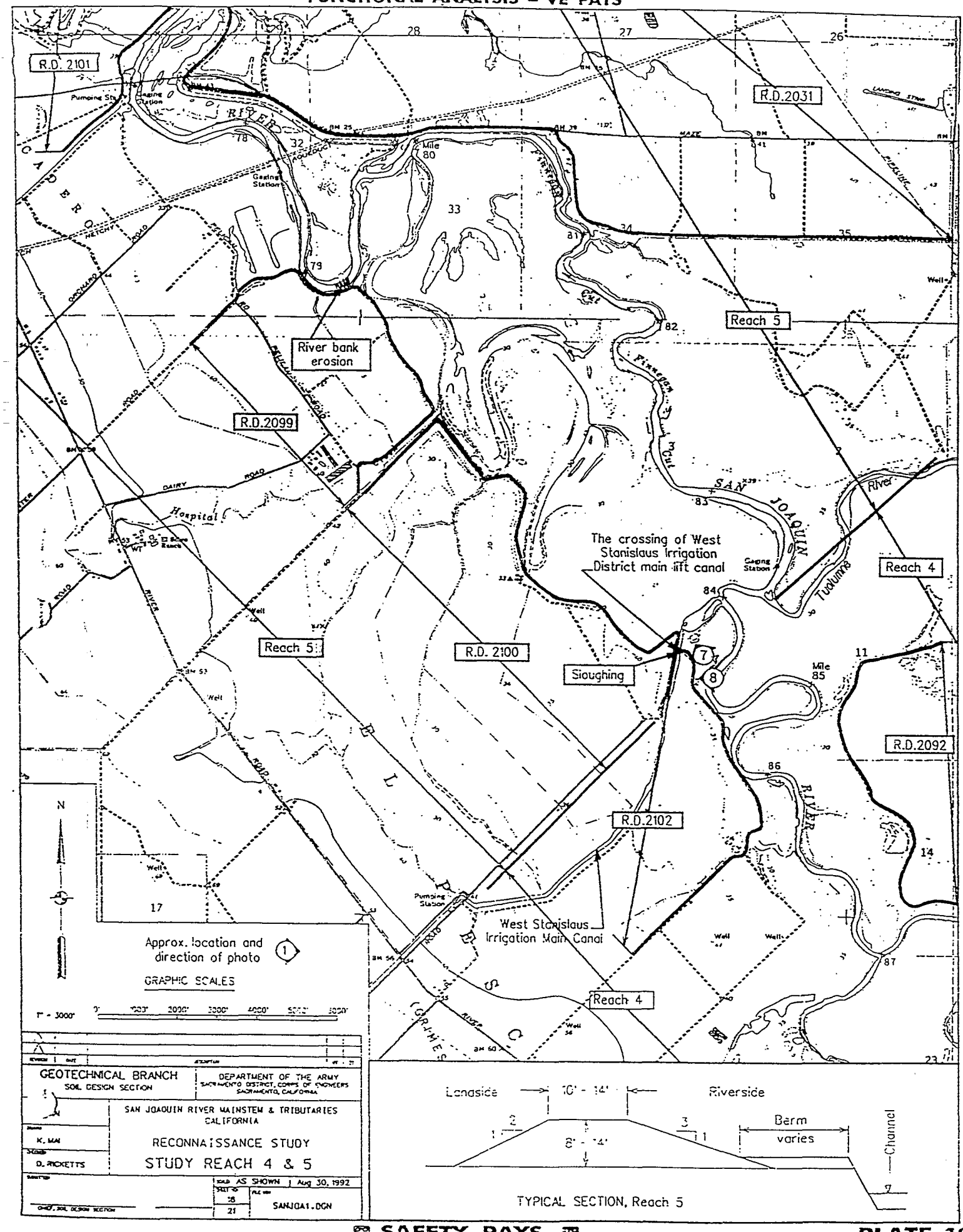
STUDY REACH 4
D. RICKETTS
K. MAN
AS SHOWN
Aug 30, 1992
SANJOA1.DGN

FUNCTIONAL ANALYSIS – VE PAYS



C—104634

C-104634



GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA

RECONNAISSANCE STUDY

STUDY REACH 4 & 5

K. MAI

D. RICKETTS

AS SHOWN | Aug 30, 1992

18

21

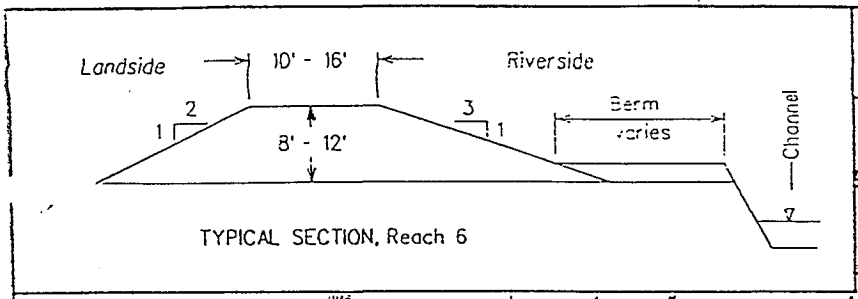
SANJOA1.DGN

SAFETY PAYS

PLATE 18

C-104635

C-104635



TYPICAL SECTION, Reach 6

Reach 6

Reach 5

R.D. 2064

R.D. 2031

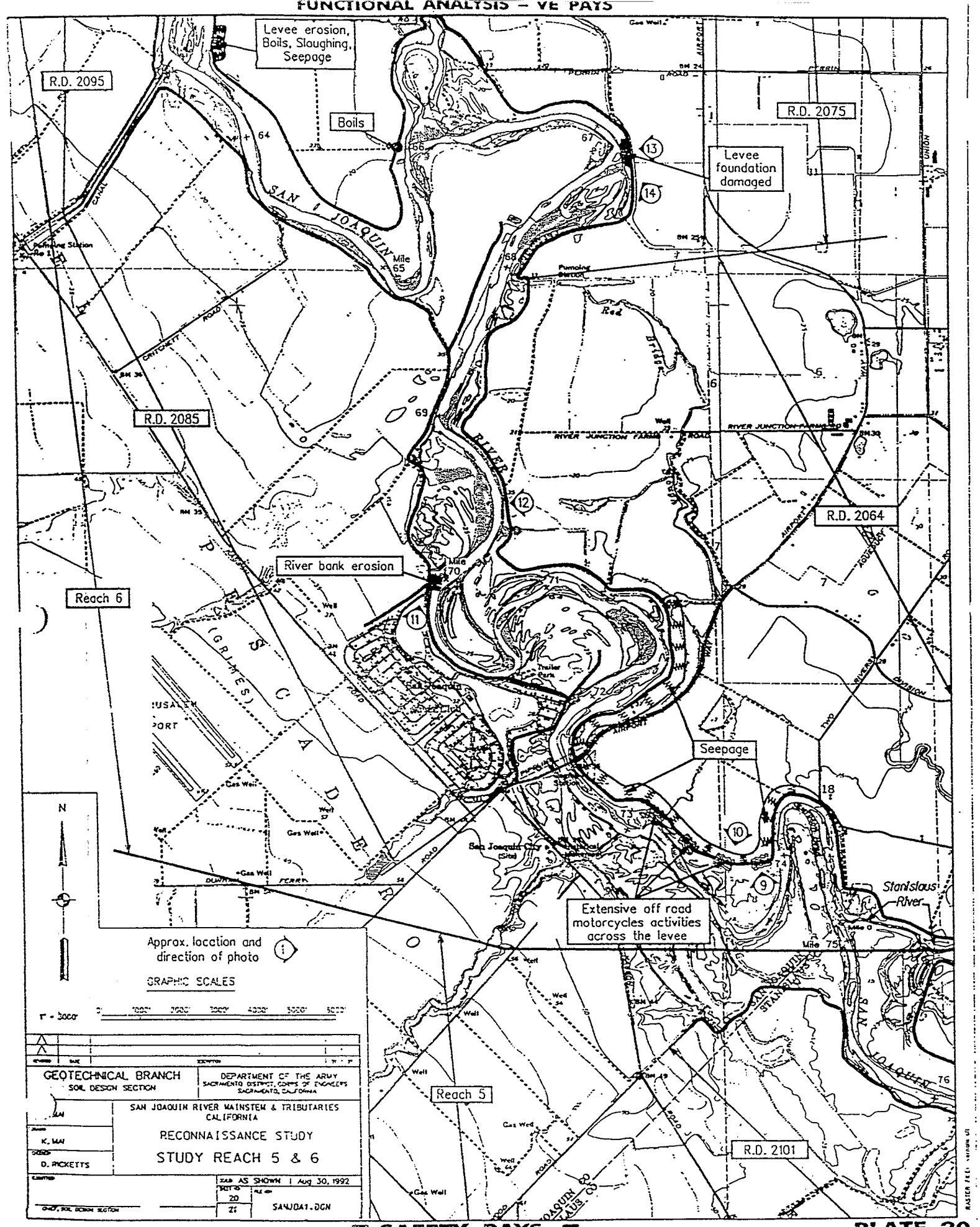
N

GRAPHIC SCALES

1" = 3000'

0' 1000' 2000' 3000' 4000' 5000' 6000'

GEOTECHNICAL BRANCH SOIL DESIGN SECTION		DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA	
DESIGNED K. MAI	SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES CALIFORNIA		
DRAWN K. MAI	RECONNAISSANCE STUDY		
CHECKED C. RICKETTS	STUDY REACH 5 & 6		
SUBMITTED CHIEF, SOIL DESIGN SECTION	SCALE AS SHOWN SHEET NO. 19 OF SHEETS 21	DATE Aug. 30, 1992 FILE NO. SANJOA1.DGN	



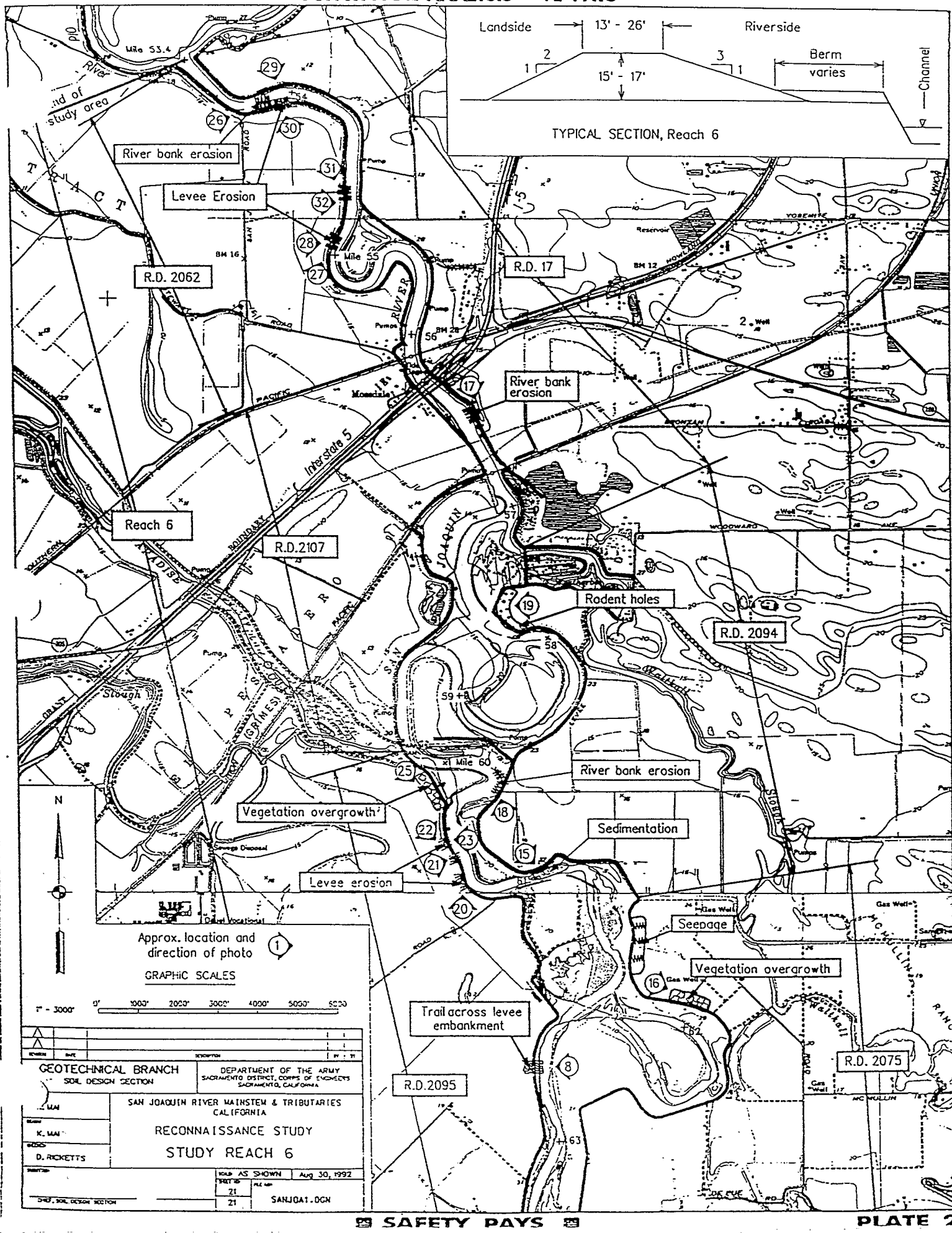
SAFETY PAYS

PLATE 20

C – 1 0 4 6 3 7

C-104637

FUNCTIONAL ANALYSIS – VE PAYS



GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SAN JOAQUIN RIVER MAINSTEM & TRIBUTARIES
CALIFORNIA

RECONNAISSANCE STUDY

STUDY REACH 6

K. MAN

D. RICKETTS

AS SHOWN | Aug 30, 1992

21 | 21 | SANJOA1.DGN

SAFETY PAYS

PLATE 21

C – 1 0 4 6 3 8

C-104638